

# The Ticks of Panama

## (Acarina: Ixodoidea)

GRAHAM B. FAIRCHILD,<sup>1</sup> GLEN M. KOHLS,<sup>2</sup> AND VERNON J. TIPTON<sup>3</sup>

Information on the ticks that occur in Panama is scattered and scanty. Most of the information hitherto available is due to the efforts of L. H. Dunn, who worked on the Isthmus for about twenty-five years. Beginning in 1915, he published a series of papers on the life histories, disease transmission potential, hosts and distribution of Panamanian ticks. Dunn's papers are listed in the bibliography. In 1941, Ernesto Osorno-Mesa published an extensive paper, with keys to genera and species, on the ticks of Colombia. In this are included a number of early records from Panama when this country was part of Colombia as well as later records assembled from the literature. Fairchild (1943) briefly summarized the records of ticks in a list which formed part of a general summary of the biting arthropods of Panama. Determinations in Osorno-Mesa's paper were largely checked by Joseph Bequaert; those in Fairchild's in part by R. A. Cooley. The Argasidae of Panama were reviewed by Cooley and Kohls (1944) in their monograph of the species occurring in North America, Central America and Cuba.

The present work is based on fairly extensive collections made in recent years by personnel of the Environmental Health Branch, Division of Preventive Medicine, Office of the Surgeon, United States Army Caribbean, especially by Charles M. Keenan, under the successive commands of Major Gordon Field, Major Robert M. Altman and Major Vernon J. Tipton; of collections made by Conrad E. Yunker and James M. Brennan of the Rocky Mountain Laboratory (RML) attached to the Middle America Research

---

<sup>1</sup> Gorgas Memorial Laboratory, Panamá, Panamá.

<sup>2</sup> United States Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Montana.

<sup>3</sup> Lieutenant Colonel, Medical Service Corps, United States Army.

The authors are listed in alphabetical order. G. B. Fairchild and V. J. Tipton assembled the material. G. M. Kohls is responsible for the taxonomy.

Unit, United States Public Health Service, in connection with their studies of Panamanian Trombiculidae; and of collections made by personnel of the Gorgas Memorial Laboratory (GML), especially Lawrence H. Dunn, Pedro Galindo V., Eustorgio Méndez and G. B. Fairchild. These collections have been largely from wild animals trapped or shot in connection with other studies, or from animals brought in alive by country people for possible sale as pets or experimental animals. In some cases, engorged nymphs or larvae allowed to detach from hosts have been held alive until they molted to the next stage, and eggs and young larvae have been secured in a few cases by holding engorged females in the laboratory, but in general our records are based on adult ticks.

A total of forty-seven species are known to occur in Panama, twelve of which are here recorded for the first time for this country. Three species, *Ixodes fuscipes* Koch, *I. minor* Neumann and *Amblyomma americanum* (Linnaeus), previously reported for Panama, are not included. Nuttall and Warburton (1911) recorded and figured as *I. fuscipes* a female from Panama from *Felis pardalis*. Cooley and Kohls (1945) suggested that this specimen may be *I. boliviensis* Neumann, but since the palpi and hypostome are missing, certainty is impossible. *I. fuscipes* is recorded from Brazil from *Dasyprocta aguti* and *Cuniculus paca* and the Rocky Mountain Laboratory has a female of this species from "agouti" from Puno (Sandia), Peru. The female reported by Fairchild (1943) as *I. minor*, from *Peromyscus nudipes* or *Oryzomys devius*, Chiriquí Province, is in fact an *Ixodes* nymph which is not further determinable. As for *A. americanum*, Dunn (1923) reported that specimens had been taken by Dr. S. T. Darling on dogs and domestic hogs on San Miguel Island, one of the Pearl Islands in Panama Bay. We have not seen these specimens and have not made collections on San Miguel. No other specimens of this species have been reported from Panama and we seriously doubt its occurrence there. It appears to be restricted to parts of the United States and Mexico.

Much remains to be learned about the ticks of Panama, and it seems advisable to point out here some of the more obvious lacunae in our knowledge. Many species appear to utilize several hosts at different stages, and the larvae and/or nymphs of many of them remain unknown or at least undescribed. The species of *Amblyomma* infesting, as adults, the sloths and anteaters, are a case in point. The larvae and nymphs of these species are undescribed and their hosts are unknown, since pre-adult stages are seldom taken on the adult's hosts. Life history studies of only a few of the commoner species have been made and these have been mostly based on laboratory rearings rather than field studies. The limiting factors of temperature, humidity, etc. affecting ticks in this area remain to be studied. The lack of coincidence between the ranges of the ticks and those of their preferred hosts is in need of investigation.

Although little detailed information has been collected concerning the effect of environmental factors on Panamanian ticks, certain generalizations may be made. In table 4 (which excludes Argasidae, *Amblyomma crassum* and *A. pictum*), we have tabulated the occurrence of various species accord-

ing to altitude (below 1000 feet, from 1000 to 5000 feet, and above 5000 feet) and according to climate (either wet or dry). As can be seen, only a few species occur in all three altitudinal zones. In some cases, the range of favored hosts may limit tick distribution, but in others, the range of the hosts is known to greatly exceed that of the ticks.

TABLE 4. DISTRIBUTION OF PANAMANIAN TICKS IN RELATION TO ALTITUDE AND CLIMATE  
(See text for detailed explanation.)

	Approximate elevation (in feet)			Climatic conditions	
	over 5000	1000-5000	under 1000	wet	dry
<i>Dermacentor halli</i>	+			+	
" <i>imitans</i>	+	+	+	+	
" <i>latus</i>	+	+		+	
<i>Anocentor nitens</i>			+	+	+
<i>Boophilus microplus</i>	+once		+		+
<i>Amblyomma auricularium</i>			+	+	+
" <i>cajennense</i>	+once	+	+	+	+
" <i>calcaratum</i>		+	+	+	+
" <i>coelebs</i>		+	+	+	
" <i>dissimile</i>		+rare	+	+	+
" <i>geayi</i>			+	+	+
" <i>longirostre</i>		+	+	+	+
" <i>napanense</i>			+	+	+
" <i>nodosum</i>			+	+	+
" <i>oblongoguttatum</i>		+	+	+	+
" <i>ovale</i>		+	+	+	+
" <i>pacae</i>	+twice	+	+	+	+
" <i>parvum</i>			+		+
" <i>pecarium</i>			+	+	+
" <i>sabanerae</i>		+rare	+	+	+
" <i>tapirellum</i>		+	+	+	+
" <i>varium</i>			+	+	+
<i>Haemaphysalis juxtakochi</i>		+	+	+	+
" <i>leporispalustris</i>	+	+	+	+	+
<i>Rhipicephalus sanguineus</i>	+	+	+	+	+
<i>Ixodes affinis</i>		+	+	+	+
" <i>boliviensis</i>	+	+		+	
" <i>brunneus</i>	+			+	
" <i>lasallei</i>		+	+	+	
" <i>loricatus</i>		+		+	
" <i>luciae</i>		+	+	+	
" <i>pomerantzi</i>	+			+	
" <i>rubidus</i>	+			+	
" <i>tapirus</i>	+			+	
" <i>tiptoni</i>	+			+	
" <i>venezuelensis</i>		+		+	

In determining the effects of climate, it is not always possible to separate the effects of temperature and humidity. In Panama, for instance, heavier and more continuous rainfall usually occurs at higher altitudes. However, it may be generally assumed that the principal factor in limiting tick distribution in areas of high elevation will be temperature, and in areas of low or intermediate elevation, humidity.

In general, the species of *Dermacentor* and *Ixodes* apparently prefer higher altitudes and areas of heavier rainfall. Of the three species of *Dermacentor*, all have been taken above 5000 feet, and only one below 1000 feet, in an area of very heavy and continuous rainfall. Among the eleven species of *Ixodes*, five have been taken only above 5000 feet and only three below 1000 feet, while only one species has been taken in a dry area. In marked contrast are the seventeen species of *Amblyomma*, of which only two, *A. cajennense* and *A. pacaе*, have been taken above 5000 feet, one species once, the other twice. Preference for dry or wet areas at low elevations is quite marked in a number of species, but only one, *A. coelebs*, has not been taken in a dry area. These facts suggest that micro-climatic factors affecting the free-living periods of some ticks may be as important in determining their distribution as are suitable hosts.

Considerable preliminary work on the disease-transmitting potential of Panamanian ticks was done by Dunn. However, complete epidemiologies have not yet been worked out, even for such obvious diseases as relapsing fever, piroplasmosis, and Rocky Mountain spotted fever. The interrelationships of ticks with wild animals and their infections, and their bearing upon general problems of parasitology and the epidemiology of diseases of man and domestic animals, comprise an area of investigation as yet almost totally unexplored.

### Family Argasidae

The Argasidae or soft ticks differ from other ticks in lacking a hard sclerotized dorsal plate, or scutum, in all stages. In nearly all cases the life history includes a six-legged larval stage and several nymphal stages, as well as the adult. In most instances, only the larvae attach themselves strongly to the host; the nymphs and adults contact the host only for brief feedings, though there are some exceptions to this generalization. The nymphs and adults are thus generally to be found free in the habitat of the hosts, while the larvae are usually found attached to the host.

Three genera of Argasidae are known from Panama. The genus *Otobius* Banks is also included in the subjoined key, as it is possible that it may eventually turn up in the drier parts of the Republic.

#### KEY TO PANAMANIAN GENERA

##### ADULTS AND LARGE NYMPHS; AFTER COOLEY AND KOHLS, 1944

1. With a definite sutural line separating the dorsal and ventral surfaces of the body ..... *Argas (persicus)*  
Sutural line absent ..... 2
2. Nymphal integument beset with spines; hypostome well developed. Integument of adults granular; hypostome vestigial..... *Otobius (megnini)*  
Integument of adults and nymphs essentially alike, mammillated or tuberculated and lacking spines; hypostome of various forms in adults and nymphs but not vestigial ..... 3
3. Hypostome broad at the base, scoop-like. Associated with bats .....  
..... *Antricola (mexicanus)*  
Hypostome of various forms but never scoop-like. Associated with various animals including bats ..... *Ornithodoros* (7 species)

## KEY TO PANAMANIAN GENERA AND SPECIES

## LARVAE

1. Claws absent, pulvilli greatly enlarged. Parasite of bats. . . . *Antricola (mexicanus)*  
Claws present, pulvilli not greatly enlarged. Parasites of various hosts including  
bats . . . . .2
2. Eyes present . . . . . *Otobius (megnini)*  
Eyes absent . . . . .3
3. Palpal segment 4 as long or longer than other palpal segments; dorsum with 26-30  
pairs of dorsal setae. Parasite of domestic fowl. . . . . *Argas (persicus)*  
Not as above . . . . . *Ornithodoros* 4
4. Parasitic on bats . . . . .5  
Parasitic on hosts other than bats. . . . .8
5. Basis capituli with a knob on each side and with a pair of pointed cornua-like ex-  
tensions ventrally. . . . . *viguerasi*  
Not as above . . . . .6
6. Hypostome on a conical base much shorter than the hypostome itself. . . . . *hasei*  
Base of hypostome about as long as the hypostome. . . . .7
7. Basal teeth of hypostome crowded and deformed. . . . . *azteci*  
Basal teeth of hypostome not crowded and deformed. . . . . *brodyi*
8. Hypostome short, approximately 0.112 to 0.130 mm. long, and bluntly rounded. . . *rudis*  
Hypostome long and pointed . . . . .9
9. Hypostome extremely long and slender, approximately 0.244 to 0.257 mm. long,  
0.038 to 0.045 mm. wide. . . . . *puertoricensis*  
Hypostome approximately 0.165 to 0.177 mm. long, 0.047 to 0.065 mm. wide. . . . *talaje*

Genus *Argas* Latreille, 1795*Argas persicus* (Oken)

*Rhynchoprion persicum* Oken, 1818, Isis, 3: 1568, figs.

*Argas persicus* (Oken), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 92, as *Argas miniatus* Koch; 1933, Amer. Jour. Trop. Med., 13, (5), p. 482. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog., no. 1, pp. 17-20, figs.

This species, the common fowl tick and the vector of fowl spirochaetosis, is the only species of the genus known from Panama. It is world-wide in distribution and is mainly a parasite of chickens; it rarely attacks man. Dunn (1923) and Fairchild (1943) report it as common throughout Panama, but our only definite record based on specimens is a large lot of nymphs and adults taken from fowl cages in the Panama City market by Fairchild a number of years ago.

Genus *Ornithodoros* Koch, 1844

## KEY TO PANAMANIAN SPECIES

## ADULTS AND LARGE NYMPHS

1. Hypostome pointed. Parasites of bats. . . . .2  
Hypostome truncated or notched at apex. Parasites of various animals including  
bats . . . . .3
2. Hypostome long, slender; denticles fine and limited to apical portion. Body ventrally  
without sclerotized plates or transverse band of columnar mammillae just pos-  
terior to coxae IV. . . . . *azteci*

- Hypostome short, flattened, in shape of an inverted V; denticles not evident when examined *in situ*. Body ventrally with sclerotized plates and with a transverse band of columnar mammillae just posterior to coxa IV.....*viguerasi*
3. Discs large, conspicuous, and occupying much of the dorsal surface.....4  
Discs small, superficial, inconspicuous, not occupying much of the dorsal surface...5
4. Small species, adults usually less than 4 mm. long. Discs as elevated shining areas. Mammillae only slightly elevated and difficult to distinguish from the discs in the posterior areas near the margin on both the dorsal and ventral surfaces. Parasite of bats.....*hasei*  
Larger species, adults usually over 4 mm. long. Discs as large depressed areas. Mammillae conical, well elevated and readily distinguished from the discs. Parasites of animals other than bats.....*puertoricensis* and *talaje*
5. Dorsoventral groove present. Legs short, leg IV not extending to posterior margin of body. Parasite of animals other than bats; frequently found in native houses.....*rudis*  
Dorsoventral groove absent. Legs long, leg IV extending beyond posterior margin of body. Parasite of bats.....*brodyi*

### **Ornithodoros azteci** Matheson

*Ornithodoros azteci* Matheson, 1935, Jour. Parasit., 21: 349-351, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog., no. 1, pp. 109-112, figs. (with *O. anduzei* Matheson 1941 as synonym).  
*Ornithodoros anduzei* Matheson, 1941, Bol. Ent. Venez., 1: 3-5.

According to Matheson (1935), larvae have been taken on the bats *Carollia perspicillata azteca* and *Desmodus rotundus murinus*, while nymphs and adults were found in cracks and crevices in a culvert at Summit (Canal Zone), in a cave on Taboga Island, and in the Chilibrillo Caves. Larvae from *Noctilio labialis* in an old building at Summit, 9 Jan. 1944, K. W. Cooper and W. Kirkland, were possibly this species. Recent collections, all of larvae, have been 6 from *Lonchorhina aurita*, railroad culvert east of Summit Golf Club, 26 Oct. 1959, V. J. Tipton; 20 from *Desmodus rotundus*, 1.5 miles W. of Santa Clara (Coclé), 27 Oct. 1959, V. J. Tipton; 2 from *Peropteryx macrotis*, Quebrada Bonita (Colón), 9 Mar. 1962, GML; 2 from bats, cave near Cement Plant (Colón), 15 Feb. 1962, C. M. Keenan.

In addition to Panama, this species has been recorded from Cuba, Jamaica, and Venezuela. The Rocky Mountain Laboratory has several lots from bats and from a cave in Trinidad collected by T. H. G. Aitken of the Trinidad Regional Virus Laboratory.

### **Ornithodoros brodyi** Matheson

*Ornithodoros brodyi* Matheson, 1935, Jour. Parasit., 21: 351-352, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog., no. 1, pp. 80-81, figs.

Larvae were taken from the short-tailed bat, *Carollia perspicillata*, and nymphs and adults from crevices in the walls and ceilings of the Chilibrillo Caves (Matheson, 1935). Fairchild (1943) records the species as common in the Chilibrillo Caves. Specimens, not now available, were taken 4 Jan., 18 Feb. 1940. Subsequent collections are as follows: Chilibrillo Caves, near Chilibre (Panamá), 27 Aug. 1944, W. W. Middlekauf, 4 adults on walls of cave; same locality, 6 and 18 Jan. 1941, K. W. Cooper and W. Kirkland,

larvae from *Carollia perspicillata*; same locality and host, 28 Oct. 1959, V. J. Tipton and C. M. Keenan, larvae; same locality, 4 Dec. 1943, GML, 2 females on walls of cave; same locality, Dec. 1946, H. Trapido, 1 female; same locality, June 1957, GML, 1 male, 4 females, 1 nymph, on walls of cave; same locality, Nov. 1954, GML, 1 larva, from *Desmodus rotundus*; Cerro Hoya (Los Santos), 6 Feb. 1962, V. J. Tipton, 1 larva, from *Trachops cirrhosus*; same locality and host, 24 Feb. 1962, 1 larva; same locality, 10 Feb. 1962, from *Carollia perspicillata*, 1 larva; bat cave, Quebrada Bonita (Colón), 25 May 1962, 1 male, 1 female, 5 nymphs; and same locality, 25 July 1962, from ? *Rhynchonycteris* sp., 1 larva.

As far as we know, all collections of *O. brodyi* from the Chilibrillo Caves came from "Cave B," the middle cave of the complex of three which make up the Chilibrillo Caves. All three open from the sides of a sink hole in limestone about 100 meters west of the present Trans-Isthmian Highway. The fauna of these caves was extensively studied and collected by L. H. Dunn, but references to his findings are scattered in the literature. Formerly the caves could be reached only by hours of travel in dugout canoes up the Chagres and Chilibrillo Rivers, and at that time they contained a large and varied bat population. In recent years their accessibility has resulted in much disturbance, including treatment with smoke bombs in connection with an anti-rabies campaign against all bats. This has resulted in the virtual disappearance of bats from Cave B and no adult ticks have been recovered on visits to the cave in recent years.

The species also occurs in Guatemala as evidenced by a nymph in the Rocky Mountain Laboratory collection from cave wall, Cueva de Lanquin, Lanquin (Alta Vera Paz), 1000 feet elevation, 15 June 1948, R. D. Mitchell and Luis de la Torre, Chicago Natural History Museum Guatemala Zoological Expedition.

### **Ornithodoros hasei** (Schulze)

*Argas hasei* Schulze, 1935, Zeitschr. Morph. Ökol. Tiere, 30: 34, fig. (May); 1941, op. cit., 37: 534, 547 (with *O. dunni* Matheson as synonym).

*Ornithodoros dunni* Matheson, 1935, Jour. Parasit., 21:347-349, figs. (October). Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog. no. 1, pp. 103-105, figs.

Schulze's material of *hasei* consisted of an unspecified number of larvae off the bat *Myotis nigricans* from "La Gueiira" (misprint for La Guaira?), Venezuela. Kohls has compared reared larvae of *O. dunni* with the larva of "*Argas*" *hasei* figured by Schulze and concurs with Schulze (1941) that *dunni* is a synonym.

Matheson's original specimens of *dunni* were reared from larvae taken from the bat *Dirias albiventer* (= *Noctilio labialis*) in Panama City and Summit (Canal Zone). Adults, nymphs and larvae have since been taken in some numbers from bat guano in the roof of an old church at Pacora (Panamá), June 21, 22, July 26, 1961. The bats inhabiting the church were *Noctilio labialis*, and one nymph and several larvae were taken from one of the bats. Several larvae, from which two nymphs later emerged, were secured from

the same species of bat taken at the Navy firing point, Galeta Point (Canal Zone), 19 Nov. 1959. More recently, three lots of larvae were secured from *Noctilio leporinus*, five lots from *Noctilio labialis*, and one each from *Uroderma bilobatum*, *Vampyrops helleri* and *Tonatia silvicola*, all from the vicinity of Las Palmitas (Los Santos), Jan.–Feb. 1962. Also, nine lots of larvae were collected from *Noctilio* sp. taken in nets, Gamboa (Canal Zone), pipeline road, 14 May 1962, by C. Yunker.

This species has also been recorded from Brazil (Marajó Island near Belém), and the Rocky Mountain Laboratory collection contains several lots from Trinidad from bats, principally *Noctilio l. leporinus*, and their roosts, collected by T. H. G. Aitken.

### ***Ornithodoros puertoricensis* Fox**

*Ornithodoros puertoricensis* Fox, 1947, Jour. Parasit., 33, (3), pp. 253–259; 1951, Jour. Parasit., 37, (1), pp. 85–95. Davis, 1955, Jour. Parasit., 41, (1), pp. 76–79. Fox and Garcia-Moll, 1961, Amer. Jour. Trop. Med. Hyg., 10, (4), pp. 566–573.

This species was described by Fox (1947) from larvae and from nymphs and adults reared from larvae collected off domestic rats in Puerto Rico. He suggested the possibility that the species was also present in Panama but that it was being confused with *O. talaje*. The presence of this species in Panama is confirmed by the finding of a larva on *Sylvilagus brasiliensis* at Los Santos, 19 February 1962, and by re-examination of a lot labeled *O. talaje* consisting of numerous larvae, 10 males, 1 female and 7 nymphs, collected by Dunn in Panama but without further data, and by another lot consisting of 7 larvae labeled *O. talaje*, from “rat”, 27 March, 1931. All specimens in these two lots proved to be *O. puertoricensis*.

The adults and nymphs of *puertoricensis* and *talaje* are so similar that we are as yet unable to distinguish the two species with certainty on the basis of these stages alone, although available specimens of *puertoricensis* are rather consistently smaller. The larvae, however, are quite distinct and are readily distinguished by characters of the hypostome. The hypostome of *puertoricensis* is much longer and narrower and ranges from approximately 0.244 to 0.257 mm. long by 0.038 to 0.045 mm. wide as compared to 0.165 to 0.177 mm. long by 0.047 to 0.065 mm. wide in *talaje* larvae reared from adults collected at and near the type locality in Guatemala.

The Rocky Mountain Laboratory has several collections of larvae from rodents (*Proechimys* and *Nectomys*) in Trinidad (T.H.G. Aitken), and larvae that were reared from adults collected at Ayacucho in Colombia. It is of interest to note that Davis (1955) interbred *O. puertoricensis* from Puerto Rico and “*O. talaje*” from Colombia and obtained fertile progeny.

### ***Ornithodoros rudis* Karsch**

*Ornithodoros rudis* Karsch, 1880, Mitt. Münch. Ent. Ver., 4: 141–142. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), pp. 582–583. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog. no. 1, pp. 101–103, figs.

*Ornithodoros talaje*, Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), pp. 92–93 (in part).

*Ornithodoros venezuelensis*, Dunn, 1933, Amer. Jour. Trop. Med., 13, (2), p. 203; 1933, Amer. Jour. Trop. Med., 13, (5), pp. 476, 482.

Dunn (1933) considers this species to be primarily a biter of man, at least in the post-larval stages. He records it as common in houses in the interior of Panama, hiding in cracks in furniture and walls and coming out to bite at night. Larvae were taken once on a chicken, and a few post-larval stages from crevices in chicken coops in the Panama City market. Fairchild collected adults and nymphs from crevices in furniture in a native house near Capira (Panamá), many years ago, and there are specimens at the Rocky Mountain Laboratory from native houses at New San Juan, Chagres River, 7 July 1939, W. Trager; from native house at Donoso (Colón), March 1947, G. B. Fairchild; and from native houses 40 miles west of Panama City, April 1954, G. B. Fairchild. No recent material has been seen, doubtless because it has not been searched for. It is also likely that extensive spraying of houses with insecticides to control malaria, beginning about 1946, has greatly reduced this domestic species. Dunn believed *O. rudis* to be the main vector to man of relapsing fever in Panama.

In addition to Panama, this species has been recorded from Colombia, Venezuela, Paraguay (Cooley and Kohls, 1944), and from Ecuador (León and de León, 1947), and the Rocky Mountain Laboratory has several collections from rodent nests from several localities in the Lancones District (Piura), Peru, October 1946 (Dr. A. Macchiavello).

#### ***Ornithodoros talaje* (Guérin-Méneville)**

*Argas talaje* Guérin-Méneville, 1849, Rev. Mag. Zool., 1: 342-344, pl. 9.

*Ornithodoros talaje*, Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 92 (in part); 1927, Jour. Parasit., 13: 177-182; 1931, Psyche, 38, (4), pp. 170-173; 1933, Amer. Jour. Trop. Med., 13, (5), pp. 475-483. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 582. Cooley and Kohls, 1944, Amer. Midl. Nat. Monog., no. 1, pp. 82-88, figs. 38-39, pl. 8. Fox, 1947, Jour. Parasit., 33: 253-259.

?*Ornithodoros dugesi* Mazzotti, 1943, Rev. Inst. Salub. Enferm. Trop., 4, (4), pp. 371-374; 1949, ibidem, 10, (3), pp. 277-281.

With the recognition that *O. puertoricensis* occurs in Panama, all previous records of *O. talaje* in Panama must be regarded as questionable. Future reports must also be so regarded unless verified on the basis of larvae in view of the close similarity of the post-larval stages of the two species. Unfortunately, none of the larvae reported by Dunn (1923, 1927, 1931, 1933) are available for study, and a positive identification as *O. talaje* of the adults now remaining in the early and more recent collections cannot be made. Consequently, the following records may apply either to *talaje*, or to *puertoricensis*, or to both, although some of the specimens appear to be the former because of their size.

Dunn (loc. cit.) recorded larvae from domestic rats (*Mus rattus*, *M. alexandrinus* and *M. norvegicus*) as well as dogs, cats, opossums, monkeys, chickens, and snake. Adults were occasionally taken in houses, once (Dunn 1931) in sufficient abundance to cause annoyance to the inhabitants by their bites. Adults were also taken in small numbers in crevices in chicken coops in the Panama City market. Dunn was of the opinion that the tick was widespread in Panama, the larvae attacking a variety of animals, the adults mainly attacking rats. He reported material from Parita (Herrera),

Santa Rosa (Colón), Gatún (Canal Zone), Chorrera and San Juan (Panamá), and the cities of Panamá and Colón. Fairchild has notes on specimens, not now available, from a native house at Villa Rosario (Panamá), 27 June 1941, sifted from dirt floor and in cracks in furniture, and a single engorged female from Juan Diaz (Panamá), July 1941, taken in a native house. Further specimens collected in houses at Villa Rosario, April 1954, are in the Rocky Mountain Laboratory collection. An adult specimen was taken while biting a man in bed, Panama City, 14 August 1944.

Cooley and Kohls (1944) stated that the range of *O. talaje* extends from Kansas and California to Argentina and noted that in the United States the species has been found only on wild rodent hosts and in association with them. Specimens taken in nests of "ratas silvestres" near Sabinas (Coahuila), northern Mexico, were described by Mazzotti (1943) as a new species, *O. dugesi*. However, Kohls has been unable to detect any significant differences between the larval and post-larval stages of *dugesi* and those of *talaje* from the United States, from native houses in southern Mexico, and from the type area in Guatemala, and believes *dugesi* may be a synonym.

#### **Ornithodoros viguerasi** Cooley and Kohls

*Ornithodoros viguerasi* Cooley and Kohls, 1941, Pub. Hlth. Rept., 56: 396-399, figs; 1944, Amer. Midl. Nat., Monog. no. 1, pp. 106-109, figs.

Our records for this species are based on larvae taken from bats, four from *Pteronotus parnellii* and one from *Pteronotus* sp. at Cueva de los Murcielagos, near Penonomé (Coclé), 4 Mar. 1955, A. Quiñonez, and 15 Dec. 1961, V. J. Tipton.

This species has been previously recorded from Cuba, and the Rocky Mountain Laboratory has several lots of larvae collected by T. H. G. Aitken from bats in Trinidad.

#### Genus **Antricola** Cooley and Kohls, 1942

##### **Antricola mexicanus** Hoffmann

*Antricola mexicanus* Hoffmann, 1959, An. Esc. Nat. Cienc. Biol., 9: 97-102, figs. (1958) (Mexico).

This species was first taken (27 males, 21 females, 4 nymphs) in December, 1961, from Cueva de los Murcielagos (bat cave) about 1 km. NW. of Penonomé (Coclé). Ticks were present in fair numbers and were actively crawling about on the guano in the first chamber in the cave. Bats of several species, predominantly *Pteronotus* spp. with a few *Carollia* sp., were present in very large numbers, forming a nearly solid sheet on the ceiling and walls of the cave. A later visit, on 24 Jan. 1962, yielded several hundred adult ticks of both sexes and nymphs of several sizes as well as 20 larvae from *Pteronotus psilotis*. A fire had been built in the cave a short time previously and bats were much less numerous. Ticks were

---

<sup>4</sup> *Neotoma micropus canescens* according to Mazzotti, 1949.

more in evidence, crawling actively on walls and floors of small side tunnels and packed into available crevices. The cave was hot and damp, the atmosphere almost unbreathable with ammonia fumes from the guano. Later, one female and one nymph were taken in a cave at Cerro Punta (Chiriquí), at an elevation of 5800 feet, and larvae from *Myotis nigricans* at the same locality.

This species was described from a female and a male found on bat guano in Gruta de Juxtlahuaca (Guerrero), Mexico. The Rocky Mountain Laboratory has a female and a nymph taken in a bat cave, elevation 6300 feet, at Chocoyos (Chimaltenango), Guatemala, 28 April 1948, by R. L. Wenzel, R. D. Mitchell and L. de la Torre, Chicago Natural History Museum Guatemala Zoological Expedition. The species resembles *A. coprophilus* (McIntosh) of the southwestern United States and Mexico, but it can be readily distinguished by the presence in females of tubercles, each bearing a tuft of long barbed hairs, on the posterior and posterolateral margins of the body.

Family Ixodidae

The Ixodidae or hard ticks are characterized by having a hard sclerotized scutum in all stages. This structure is small in the larval and nymphal stages and in the female, but covers the whole dorsum in the males. All stages attach to their hosts for relatively long periods of feeding. A few species stay on the same host in developing from larva to nymph to adult, but most species, in each stage, drop from the host on completion of feeding and after molting may parasitize the same or widely different host species. Seven genera, keyed below, have representatives in Panama.

KEY TO PANAMANIAN GENERA

MALES AND FEMALES

1. Anal groove distinct and contouring the anus anteriorly. Eyes, ornamentation, and festoons absent. Venter of male more or less completely covered by seven hardened non-salient plates ..... *Ixodes*  
 Anal groove distinct or indistinct but contouring the anus posteriorly. Eyes, ornamentation and festoons present or absent. Venter of male with or without salient plates ..... 2
2. Eyes absent, scutum inornate. Palps short and broad, base of second segment projecting laterally beyond the basis capituli. Festoons present. Venter of male without plates ..... *Haemaphysalis*  
 Eyes present ..... 3
3. Palps usually long and slender, longer than the basis capituli; segment 2 at least one and one-half times longer than segment 3. Scutum usually ornate. Venter of male without extensive salient plates, rarely with small sclerotized non-salient plaques near the festoons. Coxa IV of males not greatly enlarged... *Amblyomma*  
 Palps short and broad, not longer than the basis capituli; segment 2 about as long as segment 3..... 4
4. Basis capituli rectangular. Scutum ornate or inornate. Male without ventral plates. Coxa IV of male much larger than other coxae..... 5  
 Basis capituli hexagonal. Scutum inornate. Male ventrally with adanal and accessory plates. Coxa IV of male not greatly enlarged..... 6
5. Scutum ornate. Festoons 11 in number. Denticles of hypostome arranged in three longitudinal rows on each side of the median line. Spiracular plate not or only slightly raised above body surface; goblets numerous and small..... *Dermacentor*

- Scutum inornate. Fестоons seven in number. Denticles of hypostome arranged in four longitudinal rows on each side of the median line. Spiracular plate prominently elevated above surface of body ..... *Anocentor*
6. Fестоons absent. Palpi very short and ridged dorsally and laterally. Coxa I with two very short spurs. Anal groove obsolete in female, indistinct in male. Male very small ..... *Boophilus*
- Fестоons present. Palpi not unusually short, not ridged. Coxa I with two long spurs. Anal groove distinct. Male moderate in size. .... *Rhipicephalus*

### Genus *Ixodes* Latreille, 1795

#### KEY TO PANAMANIAN SPECIES

##### FEMALES

1. Hypostome with only files 1 and 2 extending the full length, files 3 never extending more than one-third the total length. .... 2  
 Hypostome with files 3 extending for half the length or more; files 4 may be present ..... 4
2. Medium-sized tick of usual appearance; basis capituli subrectangular, not expanded laterally; coxa I with internal spur slender and much longer than the external ..... *rubidus*  
 Large ticks of unusual appearance: basis capituli expanded laterally; dorsally with a pair of anteriorly converging ridges; coxa I with spurs flattened and robust. . 3
3. Coxa I with spurs subequal in length. .... *loricatus*  
 Coxa I with external spur much longer than the internal. .... *luciae*
4. Coxa II without spurs. .... 5  
 Coxa II with an external spur. .... 7
5. Coxae III and IV without spurs. Auriculæ mild ridge-like protuberances. Parasite of tapirs ..... *tapirus*  
 Coxae III and IV each with a short external spur. Auriculæ long retrograde processes. Parasites of small mammals. .... 6
6. Auriculæ as sharply pointed curved horns. Hypostome situated on a conical base about as long as the hypostome itself. Punctations of scutum rather uniformly distributed ..... *venezuelensis*  
 Auriculæ as long, straight, blunt, retrograde processes. Base of hypostome about half as long as the hypostome. Large punctations of scutum grouped near the posterior margin. .... *lasallei*
7. Coxa I with a short internal spur, less than twice as long as the external spur. Trochanters I to III with small, but distinct, ventral spurs. Scutum, postscutal areas, and venter with numerous conspicuous long white hairs. Parasites of birds ..... *brunneus*  
 Coxa I with internal spur much longer than the external spur. Trochanters without spurs. Parasite of mammals. .... 8
8. Cornua absent, posterior margin of basis capituli an even, concave, salient edge. Auriculæ mild lateral saliences. Punctations near posterior margin of scutum conspicuous, deep circular. .... *affinis*  
 Cornua present ..... 9
9. Palpal segment 1 with a long, sharp, ventral process. Auriculæ long, thin curved horns. Parasite of *Sylvilagus*. .... *pomerantzi*  
 Palpal segment 1 with a suboval ventral plate or a short ventral spur similar to the external spurs of the coxæ. .... 10
10. Palpal segment 1 with a suboval ventral plate. Auriculæ stout, curved, slightly longer than broad. Internal spur of coxa I long, slim, reaching nearly across coxa II in unfed specimens. .... *boliviensis*  
 Palpal segment 1 with a short ventral spur similar to the external spurs of the coxæ. Auriculæ mild, slightly pointed elevations. Internal spur of coxa I

moderate, slightly overlapping coxa II. Parasite of squirrels (*Sciurus granatensis* so far as known) . . . . . *tiptoni*

#### MALES

(Males of *rubidus*, *tapirus*, and *venezuelensis* unknown)

1. Hypostome with large lateral denticles conspicuous and well differentiated from the small median denticles which are in diagonal or transverse crenulations . . . *affinis*  
Hypostome with smaller lateral denticles not well differentiated from the medians which may be in longitudinal files as in females or with small, mild teeth in indefinite files, or in diagonal transverse crenulations . . . . . 2
2. Median denticles of hypostome in definite lineal files. Large ticks of unusual appearance: basis capituli expanded laterally, dorsally with a pair of anteriorly converging lateral ridges; lateral body folds wide; coxa I with spurs flattened and robust . . . . . 3  
Median denticles in diagonal or transverse crenulations, or faint or indefinite lineal files. Smaller ticks of usual appearance . . . . . 4
3. External spur of coxa I much longer than internal . . . . . *luciae*  
External and internal spur of coxa I about equal . . . . . *loricatus*
4. Hypostome distinctly notched apically . . . . . 5  
Hypostome not notched apically . . . . . 7
5. Coxae I and II without external spur, posterior margins broadly rounded and salient. Internal spur of coxa I long. Scutum with large punctations limited mainly to lateral and posterior areas . . . . . *lasallei*  
Coxae I and II with external spur . . . . . 6
6. Trochanters each with a small but distinct ventral spur. Spurs of coxa I short, subequal. Small tick, up to about 2 mm. long exclusive of capitulum. Parasite of birds . . . . . *brunneus*  
Trochanters without ventral spurs. Coxa I with internal spur medium and much longer than external spur. Larger tick, up to at least 2.4 mm. long exclusive of capitulum. Parasite of squirrels (*Sciurus granatensis* so far as known) . . . *tiptoni*
7. Cornua present, short, pointed. Posterointernal margin of coxa IV salient and spur-like. Hypostome slender, longitudinally grooved ventrally, with about 12 diagonal rows of crenulations. Parasite of *Sylvilagus* . . . . . *pomerantzi*  
Cornua absent. Posterointernal margin of coxa IV smoothly rounded. Hypostome broad, heavy, with about eight transverse rows of crenulations plus a basal row of large irregular teeth which are well elevated above the smooth basal portion of the hypostome . . . . . *boliviensis*

#### *Ixodes affinis* Neumann

*Ixodes affinis* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 120-121. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 29-34 (with *I. ricinus aragaoi* Fonseca, 1935 as synonym). Fonseca, 1960, Acarologia, 2, (1), pp. 9-10.

*Ixodes ricinus aragaoi* Fonseca, 1935, Mem. Inst. Butantan, 9: 131-135.

*Ixodes aragaoi* Fonseca. Aragão and Fonseca, 1952, Mem. Inst. Oswaldo Cruz, 50: 727-728. Fonseca, 1960, Acarologia, 2, (1), pp. 9-10.

Dunn (1923, 1934) recorded specimens, probably of this species, as *I. ricinus*, from near Camp Pital and from the Boqueron River area. Fairchild (1943) recorded adults from *Mazama* and *Odocoileus* from El Real (Darién) and Alhajuela (Canal Zone), while Cooley and Kohls (1945) recorded adults from *Felis concolor* (puma) from Almirante (Bocas del Toro). We have secured considerable material listed below, all collected by personnel of the Gorgas Memorial Laboratory unless otherwise stated, which indicates a wide distribution in Panama and considerable variety of hosts,

though deer and the larger carnivores seem preferred.

Juan Mina (Canal Zone), 4 Sept. and 6 Jan. 1944, from *Odocoileus*, 4 females; Santa Rosa, Río Chagres, 24 Feb. 1944, from ocelot, 1 female; Moja Pollo, Río Chagres, 19 Feb. 1941, from dog, 1 female; Gamboa pipeline road (Canal Zone), 16 Oct. 1960, V. J. Tipton, from *Felis onca*, 1 female; Piña (Colón), 22 Dec. 1957, R. M. Altman, from *Didelphis marsupialis*, 1 male, 1 female; Tacarcuna Yellow Fever Station (Darién), 3 Sept. 1958, from *Mazama americana*, 1 female; Río Teribe (Bocas del Toro), 10 Aug. 1962, from *Mazama americana*, 3 males, 9 females; Cerro Pirre (Darién), 4 Feb. 1961, C. M. Keenan and C. E. Yunker, from ocelot, 1 female; Río Chucunaque (Darién), 17 Feb. 1958, from *Mazama*, 1 male, 1 female; Río Mandinga (San Blas), 30 May 1957, from *Felis onca*, 2 males, 1 female; Almirante (Bocas del Toro), 13 March 1961, from *Felis pardalis*, 2 males, 7 females.

The range of *I. affinis* extends from Georgia (Lund, Marshall and Hayes, 1962) and Florida (Kohls and Rogers, 1953) to Brazil. Cotype females of *aragaoi* (Brazil) have the punctations near the posterior margin of the scutum somewhat smaller than in *affinis* but we do not regard this and other minor differences noted by Aragão and Fonseca (1952) and Fonseca (1960) as sufficient to justify recognition of *aragaoi* as a separate species.

### *Ixodes boliviensis* Neumann

*Ixodes boliviensis* Neumann, 1904, Arch. Parasit., 8: 457-458. Kohls, 1956, Proc. Ent. Soc. Wash., 58: 232-233 (with *I. bicornis* as synonym).

*Ixodes bicornis* Neumann, 1906, Arch. Parasit., 10: 196-197. Fairchild, 1943, Amer. Jour. Trop. Med., 23: 583. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 183-186. Kohls, 1956, Proc. Ent. Soc. Wash., 58: 232-233.

Fairchild (1943) and Cooley and Kohls (1945) reported this species as *I. bicornis*, from man, domestic cat and dog from several localities in Chiriquí Province. Since then we have secured 44 lots from the following hosts: jaguar (3 lots, 3 males, 51 females); dog (15 lots, 21 males, 143 females, 1 nymph); tapir (3 lots, 12 females); *Didelphis marsupialis* (3 lots, 4 females); *Procyon lotor* (1 lot, 3 males, 9 females, 8 nymphs, 15 larvae); cattle (4 lots, 1 male, 18 females); *Odocoileus* (1 lot, 4 females); mule (1 lot, 5 females); domestic cat (1 lot, 1 female); man (4 lots, 1 male, 4 females, only 1 female attached); *Coendou mexicanus* (4 lots, 10 females); *Nasua nasua* (3 lots, 15 females); in camp building (1 lot, 1 female). All were collected at elevations of over 2500 feet in Chiriquí Province or in neighboring Bocas del Toro Province. *I. boliviensis* appears to be the principal tick on dogs in this area, and on several occasions large numbers have been taken from a single dog. Its range extends from Mexico to Bolivia.

### *Ixodes brunneus* Koch

*Ixodes brunneus* Koch, 1844, Arch. Naturg., 10: 232. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 205-211. Anastos and Smith, 1957, Jour. Parasit., 43: 535-541 (male, nymph, and larva described).

*Ixodes californicus* Banks, 1904, Proc. Cal. Acad. Sci., 3, (3), p. 369. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 215-216. *New synonymy*.

A single female from an undetermined species of tinamou, Bambito (Chiriquí), 6 Feb. 1960, collected by V. J. Tipton and C. M. Keenan, appears to be the first record of this bird tick from Panama. The specimen is somewhat larger than those from the United States, the scutal hairs are shorter, fewer and finer, and the median field of the scutum is glossy and has fewer and smaller punctations.

This species is known from several States in the United States (excluding Alaska and Hawaii) and from Venezuela. Boero (1945) identified as *I. brunneus* a female from the marsupial *Dromiciops australis australis* and a nymph from a supposed bat's roost, both from Victoria Island in Lake Nahuel (Neuquen), Argentina, but Ringuelet (1947) examined the specimens and described them as a new species, *Ixodes neuquenensis*. Boero's (1957) identification as *brunneus* of a female from a bird, *Turdus nigriceps*, Jujuy Province, Argentina, may be correct but his description and figures suggest that it may be another species.

Kohls has recently compared the syntype nymphs of *I. californicus* with authentic nymphs of *I. brunneus* and found them to be the same.

#### *Ixodes lasallei* Mendez and Ortiz

*Ixodes lasallei* Mendez and Ortiz, 1958, Mem. Soc. Cienc. Nat. LaSalle, 18: 198-202.

This species was described from females from Venezuela, taken from *Agouti paca*. We have secured 10 lots, including the undescribed male, 8 from *Dasyprocta punctata* and 2 from *Agouti paca*: Almirante (Bocas del Toro), 23 Jan. 1960, V. J. Tipton and C. M. Keenan, 1 female; same locality, 24 Jan. 1962, 1 female; same locality, 18 July 1960, GML, 1 female; Río Teribe (Bocas del Toro), 10 Aug. 1962, GML, 3 females; Cerro Hoya (Los Santos), 15 Feb. 1962, V. J. Tipton and C. M. Keenan, 7 nymphs, 2 larvae; same locality, 17 Feb. 1962, 1 female; same locality, 22 Feb. 1962, 2 nymphs; same locality, 23 Feb. 1962, 1 nymph; Timi de Boa, Río Teribe (Bocas del Toro), from *Agouti paca*, GML, May 1962, 1 male, 8 females, and 4 nymphs, and 10 Aug. 1962, 3 nymphs.

The salient morphological features of the male of this species are given in the key to *Ixodes* males.

#### *Ixodes loricatus* Neumann

*Ixodes loricatus* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 139-142. Nuttall and Warburton, 1911, Ticks, pt. 2, pp. 266-269. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 187-193.

Although this species was erroneously reported from Panama as *I. loricatus spinosus* by Fairchild (1943), the following seems to be the first authentic record of the species from Panama: Tacarcuna Yellow Fever Station (Darién), 1 Sept. 1958, GML, from *Metachirus nudicaudatus*, 1 female.

The range of this species extends from Mexico to Argentina. Its principal hosts appear to be opossums (Family Didelphidae) but it has been recorded from a variety of other animals.

*Ixodes didelphidis* Fonseca and Aragão, 1952, described from adults

taken on *Metachirus* sp. and *Didelphis paraguayensis* at Anápolis (Goiaz), Brazil, differs from *loricatus* in having somewhat larger spiracular plates with slightly smaller and more numerous goblets, and probably represents only a local population of that species. There are numerous lots from Anápolis in the Rocky Mountain Laboratory collection.

### *Ixodes luciae* Senevet

*Ixodes luciae* Senevet, 1940, VI Cong. Intern. Ent., Madrid, (1935), pp. 896-898. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 175-180. Kohls, 1957, Proc. Ent. Soc. Wash., 59, (6), p. 259 (with *I. loricatus vogelsangi* Dias, 1954 as synonym).

*Ixodes loricatus* var. *spinosus* Nuttall, 1910, Parasitology, 3: 411-412, preoccupied by *I. spinosus* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 146-147, = *I. fuscipes* Koch, 1844. Fairchild, 1943, Amer. Jour. Trop. Med., 23: 583.

*Ixodes scuticrenatus* Vazquez, 1946, An. Inst. Biol., 17: 237-245. *New synonymy.*

Aside from the specimens from *Didelphis marsupialis* from Alhajuela (Canal Zone), L. H. Dunn, reported by Fairchild (1943), and Cooley and Kohls (1945), we have secured the following additional material.

From *Didelphis marsupialis*, 20 lots totaling 33 males, 27 females, from the following localities: Tacarcuna Station (Darién), Aug.-Sept. 1958; Río Mandinga (San Blas), 27 May 1957; Cerro Azul (Panamá), May, Aug. 1955, Jan.-Apr. 1956; Cerro Campana (Panamá), March 1961; Camp Piña (Canal Zone), May, Aug. 1955, Jan., March 1956. From *Philander opossum*, 6 lots totaling 7 females, from Cerro Azul (Panamá), 21 Dec. 1955; Camp Piña (Canal Zone), 19 Jan., 9 March, 1956; Fort Gulick (Canal Zone), 21 March 1961. From *Marmosa robinsoni*, 1 nymph, Almirante (Bocas del Toro), 22 Feb. 1960. From *Zygodontomys microtinus*, 1 nymph, Tacarcuna Station (Darién), 3 Sept. 1958. From *Oryzomys* sp., 2 nymphs, Cerro Pirre, 1600 feet (Darién), 6 Feb. 1961.

The above records indicate that opossums are the favored hosts for the adults, but suggest that rodents are preferred by the earlier stages. The localities are all in areas of high rainfall, from sea level to about 2000 feet elevation.

In addition to Panama, this species has been recorded from southern Mexico, British Honduras, Guatemala, Colombia, Venezuela, Peru, French Guiana, Brazil and Argentina. The Rocky Mountain Laboratory has numerous lots, including many larvae and nymphs from rodents, that were collected in Trinidad by Dr. T. H. G. Aitken of the Trinidad Regional Virus Laboratory.

### *Ixodes pomerantzi* Kohls

*Ixodes pomerantzi* Kohls, 1957, Jour. Parasit., 42, (6), pp. 639-642 (Dec. 1956).

Only three lots of this tick have been taken, all from *Sylvilagus brasiliensis*, as follows: Casa Tilley, Cerro Punta (Chiriquí), 1 May 1960, V. J. Tipton and C. M. Keenan, 2 males, 1 female, 13 nymphs; Bambito (Chiriquí), 5100 feet, 7 March 1962, V. J. Tipton, 1 male, 2 females, 17 nymphs; same locality, 13 March 1962, V. J. Tipton, 1 male, 1 female, 9 nymphs.

The species was described from adults from *Sylvilagus brasiliensis* in Peru and *S. floridanus chiapensis* in Guatemala.

### ***Ixodes rubidus* Neumann**

*Ixodes rubidus* Neumann, 1901, Mém. Soc. Zool. Fr., 14: 282–283. Nuttall and Warburton, 1911, Ticks, pt. 2, pp. 175–176. Cooley and Kohls, 1945, Nat. Inst. Hlth. Bull., no. 184, pp. 153–156.

In addition to the 13 females from *Eira barbara* reported by Cooley and Kohls (1945) from Boquete (Chiriquí), we have secured five additional lots as follows: Nueva Colonia (Chiriquí), 30 Jan. 1960, V. J. Tipton and C. M. Keenan, from *Procyon lotor*, 7 females, 7 nymphs, 15 larvae; Bambito (Chiriquí), 15 Feb. 1960, V. J. Tipton and C. M. Keenan, from *Mustela frenata*, 1 female; Casa Tilley, Cerro Punta (Chiriquí), 5300 feet, 12 March 1962, V. J. Tipton, from *Conepatus semistriatus*, 9 females, 17 nymphs; Bambito (Chiriquí), 5100 feet, 12 March 1962, V. J. Tipton, from *Bassaricyon gabbii*, 3 females, 4 nymphs; and 13 March 1962, from *Nasua nasua*, 1 female. All of our material has come from small, wild carnivores of the families Procyonidae and Mustelidae, and from localities over 5000 feet in Chiriquí Province. The species was described from a female from *Bassariscus astutus*, Guanajuato, Mexico, and the Rocky Mountain Laboratory has 2 females from *Didelphis* sp., Yepocapa (Chimaltenango), Guatemala, 19 Jan. 1949, H. T. Dalmat. The male remains unknown.

### ***Ixodes tapirus* Kohls**

*Ixodes tapirus* Kohls, 1957, Jour. Parasit., 42, (6), pp. 642–643, (Dec. 1956).

Two lots of this recently described species, both from tapir, *Tapirus bairdii*, have been secured. Upper Río Changuinola (Bocas del Toro), 10 May 1959, R. Hartmann, 1 female, and Río Candela (Chiriquí), 6600 feet, Oct. 1953, R. Hartmann, 5 females. This species was previously known from a female from the woolly, or mountain tapir, *Tapirus pinchaque*, Río Majuas, about 8600 feet, San Agustín (Huila), Colombia.

### ***Ixodes tiptoni* Kohls and Clifford**

*Ixodes tiptoni* Kohls and Clifford, 1962, Jour. Parasit., 48, (2), pp. 182–184.

Records of this recently described species will be found listed in detail in the original description. Subsequent collections include larvae, nymphs, females and a single male, from *Sciurus granatensis* and from rodent and bird nests, the latter probably in use by mammals, possibly squirrels. One lot is from Río Changena (Bocas del Toro), 6000 feet, the others from the vicinity of Cerro Punta (Chiriquí).

The important morphological features of the male are given in the key to the males of this genus.

### ***Ixodes venezuelensis* Kohls**

*Ixodes venezuelensis* Kohls, 1953, Jour. Parasit., 39, (3), pp. 300–303.

We have taken only females of this species and all but one lot came from a

camp on the slopes of Mount Tacarcuna (Darién). Tacarcuna Yellow Fever Station, 31 Aug. 1958, GML, from *Zygodontomys microtinus*, 3 females; 1 Sept. 1958, same host, GML, 2 females; 2 Sept. 1958, same host, GML, 1 female; 7 Sept. 1958, same host, GML, 3 females; 20 March 1959, GML, from *Monodelphis adusta*, 1 female; Cerro Azul (Panamá), 14 March 1961, C. E. Yunker, from *Oryzomys* sp., 1 female.

Kohls (1953) recorded females and nymphs of this species from *Heteromys anomalus anomalus* and *Monodelphis brevicaudata palliolata*, State of Aragua, Venezuela, and females from *Oryzomys caliginosus* and *Necotomys alfari*, Antioquia, Colombia. Vogelsang and Dias (1953) recorded a female from *Mus musculus*, State of Aragua, Venezuela. The male is unknown.

### Genus *Anocentor* Schulze, 1937

The one known species in this genus is widely distributed in the New World from southern Texas, Florida, and the West Indies southward to Brazil. It is commonly referred to as the "tropical horse tick."

#### *Anocentor nitens* (Neumann)

*Dermacentor nitens* Neumann, 1897, Mém. Soc. Zool. Fr., 10: 376-378. Dunn, 1915, Ent. News, 26: 214-219; 1923, Amer. Jour. Trop. Med., 3, (2), pp. 93-94. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583.

*Otocentor nitens* (Neumann), Cooley, 1938, Nat. Inst. Hlth. Bull., no. 171, pp. 65-68, figs.

*Anocentor columbianus* Schulze, 1937, Zool. Anz., 120: 24-27, figs.

Dunn (1923, 1934) reports this tick as primarily a parasite of horses and mules in Panama; often all stages are found on the host simultaneously. He also indicates that the ticks seem to prefer the ears. Fairchild (1943) noted that it is often taken on cattle and that it was taken twice from deer. Subsequent records include thousands of specimens collected by Field in 1954-1955 from horses in horse-baited mosquito traps at Fort Davis, and lesser numbers from horses at Fort Clayton. It is a curious fact that this New World tick is now very largely confined to domestic animals of Old World origin. Observations on the biology of this tick in Panama are given by Dunn (1915).

### Genus *Dermacentor* Koch, 1844

#### KEY TO PANAMANIAN SPECIES

##### MALES AND FEMALES

1. Spurs of coxa I with proximal edges parallel or only slightly divergent.....*latus*  
Spurs of coxa I widely divergent.....2
2. Males ventrally with a short retrograde tubercle on some of the festoons. Female scutum with whitish ornamentation indistinct; tarsi II to IV each with strong, sharp, subterminal and apical ventral spurs.....*imitans*  
Males ventrally without tubercles on the festoons. Female scutum with distinct whitish ornamentation; tarsi II to IV each with the subterminal ventral spur blunt and much shorter than the apical ventral spur.....*halli*

Only one species of this genus has been hitherto recorded from Panama, *D. latus* Cooley (Fairchild, 1943). Extensive collecting in the highlands of Chiriquí and Darién Provinces has added two species and has indicated that the species in the genus appear to prefer a cool environment.

### ***Dermacentor latus* Cooley**

*Dermacentor latus* Cooley, 1937, Jour. Parasit., 23: 262-264, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Arthur, 1960, Ticks, pt. 5, pp. 102-103, figs. (fig. 185 is of scutum of *D. dispar*, not *D. latus* as stated). Clifford and Kohls, 1962, Jour. Parasit., 48: 486-488, figs.

This species was described from a single male from tapir in Costa Rica. Fairchild (1943) reported a male from dog, Boquete (Chiriquí). We have since secured additional material as follows: Río Candela (Chiriquí), >5000 feet, 20 Aug. 1954, R. Hartmann, from man, 1 male; Río Candela, >6000 feet, Dec. 1953, R. Hartmann, from tapir, 12 males, 12 females; Upper Río Changuinola (Bocas del Toro), >6000 feet, 10 May 1959, R. Hartmann, from tapir, 36 males, 12 females; Río Changena (Bocas del Toro), 2400 feet, 16 Sept. 1960, C. M. Keenan and C. E. Yunker, from tapir, 16 males, 12 females; Río Changena, >6000 feet, 8 Sept. 1961, V. J. Tipton, from man, 1 female. We feel that the tapir is probably the true host of this tick in the adult stage.

The female of the species was described by Clifford and Kohls from specimens from Río Candela and Río Changuinola.

### ***Dermacentor halli* McIntosh**

*Dermacentor halli* McIntosh, 1931, Jour. Parasit., 18: 124 (brief description); 1932, Proc. U. S. Nat. Mus., 82, art. 4, pp. 1-6, figs. Cooley, 1938, Nat. Inst. Hlth. Bull., no. 171, pp. 55-58, figs. Arthur, 1960, Ticks, pt. 5, pp. 69-74, figs.

The previous range of this species was from Yucatan, Mexico, north to extreme southern Texas, and the hosts were peccary and skunk. Our records are all from the vicinity of Cerro Punta (Chiriquí), at about 5000 feet, collected by V. J. Tipton and C. M. Keenan (unless otherwise indicated), as follows: 3 May 1960, from rodent nest, 4 males, 1 female, 1 nymph; 4 May 1960, from rodent nest, 2 males; 10 Jan. 1961, C. E. Yunker, from mouse, 1 male reared from nymph; 6 March 1962, from *Coendou mexicanus*, 2 males, 1 female; 11 March 1962, same host, 1 male; 8 March 1962, same host, 7 males, 2 females; 6 March 1962 from *Myotis nigricans*, 1 nymph; Bambito (Chiriquí), 12 March 1962, from *Coendou mexicanus*, 1 male, 2 females; same data, 5 males, 1 nymph. The specimen from *Myotis* is possibly a stray.

The Rocky Mountain Laboratory has records of this species as follows: from peccary, Los Pozos (Sinaloa), Mexico, 26 Dec. 1937, 1 male; from man or vegetation, Taninul (San Luis Potosí), 24 Aug. 1961, 1 male, R. B. Eads; from *Coendou mexicanus*, San Pedro Yepocapa (Chimaltenango), Guatemala, April 1949, 5 males, 3 females, H. T. Dalmat; same host, locality and collector, 9 Feb. 1950, 1 female; and 15 April 1951, 8 males, 3 females; same host and collector, Acatenango (Chimaltenango), Guatemala, 8 Feb. 1951, 1 male, 2 females; from sloth, near San José, Costa Rica, March 1962, J. J. Shaw, 1 female.

The specimens from Panama, Costa Rica, and Guatemala differ somewhat from those from Texas and Mexico. They are more slender and narrowed anteriorly, the palpi are thinner, the porose areas tend to be larger, and the females from Panama have the cornua much reduced or absent. If these ticks are actually *D. halli* as we assume them to be, it is strange that there are no records of this species from peccaries in Panama or elsewhere in Central America.

### **Dermacentor imitans** Warburton

*Dermacentor imitans* Warburton, 1933, Parasitology, 24: 559-560, figs. Cooley, 1937, Jour. Parasit., 23: 261, figs. Arthur, 1962, Ticks, pt. 5, pp. 97-98, figs.

This species, previously known only from the type lot consisting of 12 males and 1 female from peccary, *Tayassu tajacu*, (= *Pecari angulatus*), at Turrialba, Costa Rica, is now known from Panama, Guatemala and Mexico as detailed below.

Our Panama material consists of 6 lots as follows: Río Candela, (Chiriquí), 20 Aug. 1954, R. Hartmann, from man, 1 male; near Almirante (Bocas del Toro), 9 Feb. 1960, C. M. Keenan and V. J. Tipton, from collared peccary, *Tayassu tajacu*, 2 males; Timishik, Río Teribe (Bocas del Toro), May 1962, from *Tayassu tajacu*, 10 males, 4 females; Cerro Pirre (Darién), 2 Feb. 1961, C. M. Keenan and C. E. Yunker, from *Tayassu tajacu*, 1 female; same locality, host and collectors, 5 Feb. 1961, 3 males; same locality, 6 Feb. 1961, C. E. Yunker and V. J. Tipton, from work table with animal skins, host unknown, 1 male. All the localities are in the highlands, over 3000 feet, except the collection from Bocas del Toro Province.

The collections of the Rocky Mountain Laboratory contain 1 male of this species from *Tayassu* sp. taken at Santa Clara near Cabanas (Zacapa), Guatemala, 1 Aug. 1948, at 5500 feet elevation by R. D. Mitchell and Luis de la Torre, Chicago Natural History Museum Guatemala Zoological Expedition. There are also 3 lots from El Ocote, Ocozocoautla (Chiapas), Mexico, 2000 feet elevation, collected by Miguel Alvarez del Toro, with data as follows: 1 male, 2 females from *Tayassu* sp., 4 May 1946; 1 male, same host and date; and 2 males from *Mazama americana*, 25 May 1950. The latter specimens are probably strays.

## Genus **Rhipicephalus** Koch, 1844

### **Rhipicephalus sanguineus** (Latreille)

*Ixodes sanguineus* Latreille, 1806, Gen. Crust. Ins., 1: 157.

*Rhipicephalus sanguineus* (Latreille), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 94. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 583. Cooley, 1946, Nat. Inst. Hlth. Bull., no. 187, pp. 24-29, figs.

The common brown dog tick, is found on nearly all dogs throughout Panama. Fairchild removed nearly a pint of ticks from a stray mongrel several years ago. Infestation of houses by this tick is not uncommon, and often leads to excited inquiries on the part of the householders, though we have not encountered evidence of the ticks actually biting man. We have

occasional records from animals in captivity, such as marmosets, capybara, and domestic rabbit, but these are no doubt accidental.

### Genus *Boophilus* Curtice, 1891

#### *Boophilus microplus* (Canestrini)

*Haemaphysalis micropla* Canestrini, 1887, Atti Soc. Veneto Trent. Sci. Nat., 11: 104.  
*Margaropus annulatus australis* (Fuller), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 95.

*Boophilus microplus* (Canestrini), Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 586. Cooley, 1946, Nat. Inst. Hlth. Bull., no. 187, pp. 17-22, figs. (with *Uroboophilus cyclops* Minning as synonym).

*Uroboophilus cyclops* Minning, 1934, Zeitschr. Parasitenk., 7: 33, figs.

This is the most abundant tick on cattle throughout Panama. We have records from as high as Cerro Punta, (5800 feet), in Chiriquí Province. Aside from twenty-three records from cattle, we have three records from horse, three from pig, and one each from goat and deer. Dunn (1923) recorded it, as *Margaropus annulatus australis* Fuller, from dogs as well. He also recorded the North American cattle tick, *B. annulatus*, from a recently imported bull, but it does not seem to have become established here.

### Genus *Haemaphysalis* Koch, 1844

#### KEY TO PANAMANIAN SPECIES

##### MALES AND FEMALES

- Palpal segment 3 with a very short retrograde ventral spur; ventral cornua present;  
 hypostome with dentition 3/3..... *leporispalustris*  
 Palpal segment 3 with a long retrograde ventral spur; ventral cornua absent;  
 hypostome with dentition 4/4 or 5/5..... *juxtakochi*

##### NYPHPS

- Coxa I with a small external spur; palpal segment 2 ventrally with 4 or more stout  
 hairs on the internal margin..... *leporispalustris*  
 Coxa I with external spur absent; palpal segment 2 ventrally with 2 fine hairs on the  
 internal margin..... *juxtakochi*

##### LARVAE

- Cornua present on basis capituli dorsally; scutum relatively narrower (approximate-  
 ly 0.25 mm. long, 0.30 mm. wide)..... *leporispalustris*  
 Cornua absent; scutum relatively broader (approximately 0.24 mm. long, 0.37 mm.  
 wide)..... *juxtakochi*

#### *Haemaphysalis juxtakochi* Cooley

*Haemaphysalis kochi* Aragão, 1908, Trab. Inst. Manguinhos, pp. 3-6 (reprint).  
 Cooley, 1946, Nat. Inst. Hlth. Bull., no. 187, pp. 44-47, figs.

*Haemaphysalis juxtakochi* Cooley, 1946, loc. cit., no. 187, pp. 48-51, figs. Kohls, 1960,  
 Jour. Parasit. 46, 3, pp. 356-358, figs. (*H. kochi* Aragão and *H. kohlsi* Aragão and  
 Fonseca, 1951 reduced to synonyms of *H. juxtakochi*.)

*Haemaphysalis kohlsi* Aragão and Fonseca, 1951, Mem. Inst. Osw. Cruz, 49: 574 (new  
 name for *H. kochi* Aragão preoccupied by *H. concinna* var. *kochi* Neumann, 1905).

Dunn (1923) and Fairchild (1943) recorded this species (as *H. kochi*)  
 from deer (*Odocoileus*) and tapir, and on vegetation, while Kohls (1960) re-

corded the species from *Odocoileus* and *Mazama*. Subsequent collections are all from the Canal Zone area, as follows: Gamboa road, 14 March 1961, N. B. Gale, from *Nasua nasua* dead on road, 3 nymphs; Juan Mina, 10 March 1944, GML, from peccary, 1 nymph; Río Casaya, 27 Feb. 1944, GML, from collared peccary, 1 nymph; Summit Gardens, 29 Aug. 1959, V. J. Tipton and C. M. Keenan, from *O. virginianus*, 24 males, 15 females; vicinity of Gamboa, 24 Oct. 1959, same collectors and host, 7 males, 6 females; Cerro Tigre, 4 July 1961, same collectors and host, 7 males, 3 females; Curundu, 10 March 1961, same collectors, from *Coendou rothschildi*, 1 nymph; Barro Colorado Island, 15 July 1960, same collectors, from *Tapirus bairdii*, 1 female.

Deer, especially *Odocoileus*, seem to be the preferred hosts of the adults, while nymphs have been secured from a variety of animals.

### **Haemaphysalis leporispalustris** (Packard)

*Ixodes leporis-palustris* Packard, 1869, Ann. Rept. Peabody Acad. Sci., p. 67.

*Haemaphysalis leporis-palustris* (Packard), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 96. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 586. Cooley, 1946, Nat. Inst. Hlth. Bull., no. 187, pp. 31-36, figs. Kohls, 1960, Jour. Parasit., 46, (3), pp. 355-361.

Dunn (1923) recorded specimens from domestic rabbit and *Dasyprocta* sp., while Kohls (1960) gave a number of records from *Sylvilagus* and birds. Nearly all of our specimens were taken from *Sylvilagus brasiliensis*, as follows: Cerro Punta (Chiriquí), 1 May 1960, V. J. Tipton and C. M. Keenan, 2 females; Río Mandinga (San Blas), 29 May 1957, P. Galindo, 6 males, 3 nymphs, 1 larva; 2 May 1957, same locality and collector, 2 females; Cerro Azul (Panamá), 15 March 1961, C. E. Yunker, 1 female held for oviposition, eggs and larvae secured; 22 March 1961, same locality and collector, 8 males, 2 females, 2 nymphs; Bambito (Chiriquí), 5100 feet elevation, 7 and 13 March 1962, V. J. Tipton, 1 male, 4 females, 4 nymphs, 1 larva; Cerro Punta (Chiriquí), 5300 feet elevation, 11 March 1962, V. J. Tipton, 2 males, 2 females, 2 nymphs; Las Palmitas (Los Santos), 19 and 28 Feb., and 1 March 1962, V. J. Tipton (4 lots), 47 males, 13 females, 40 nymphs, 2 larvae; El Hato (Chiriquí), 7 Jan. 1961, L. C. Wislocki and C. E. Yunker, from *Peromyscus* sp., 1 larva.

### Genus *Amblyomma* Koch, 1844

#### KEY TO PANAMANIAN SPECIES

##### MALES <sup>5</sup>

- |   |    |
|---|----|
| 1. Marginal groove complete, limiting all festoons.....   | 2  |
| Marginal groove incomplete or absent.....   | 10 |
| 2. Coxa I with two long equal or subequal spurs, both spurs at least twice as long as broad ..... | 3  |
| Coxa I with one or both spurs short or medium.....  | 6  |

---

<sup>5</sup> Excluding *crassum* Robinson, 1926. We have not seen males but we believe the description by Mendez and Ortiz (1957) may be that of another species, perhaps *sabanaerae*.

3. Spurs on coxa I very long and acute, much longer than the spur on coxa IV, the external spur slightly curved outward near the tip. Body elongate oval. . . . . *ovale*  
 Spurs on coxa I as long as spur on coxa IV or shorter. . . . . 4
4. Coxa I with broad stout spurs. Scutum with punctations numerous, large and deep . . . . . *coelebs*  
 Coxa I with slender acute spurs. Scutum with punctations few and fine. . . . . 5
5. Body broad oval. Elements of scutal pattern all of about equal intensity. Medium sized species . . . . . *tapirellum*  
 Body elongate oval, lateral margins subrectilinear. Longitudinal elements of scutal pattern accentuated, giving a more striped appearance. Very small species . . . . . *oblongoguttatum*
6. Scutum with elongate, keel-like ridge in posteromedian area. . . . . *pecarium*  
 Scutum without keel-like ridge. . . . . 7
7. Palpal segment 1 with a stout ventral retrograde spur. Trochanters I-IV each with a small ventral spur. Scutum inornate or very slightly ornate. Small species . . . . . 8  
 Palpal segment 1 without ventral spur. Trochanters without spurs. Scutum distinctly ornate . . . . . 9
8. Coxa I with internal spur much shorter than the external. Scutum inornate. . . . . *parvum*  
 Coxa I with short sub-equal spurs. Scutal ornamentation indistinct or absent . . . . . *auricularium*
9. Capitulum sub-rectangular. Coxae II and III each with spurs in the form of a broad salient ridge; a long stout spur on coxa IV. . . . . *cajennense*  
 Capitulum trapezoidal. Coxae II-IV each with a short triangular spur. Ventral plaques large . . . . . *geayi*
10. Marginal groove incomplete, terminating posteriorly at the third festoon on each side. Body large, elongate oval. Ventral plaques large. Coxa I with two small unequal spurs; coxae II-IV each with a single short, pointed spur. . . . . *longirostre*  
 Marginal groove absent . . . . . 11
11. Coxae II-IV each with two spurs (internal spur of IV sometimes absent). Parasites of reptiles and amphibians. . . . . 12  
 Coxae II-IV each with a single spur. Parasites of mammals. . . . . 13
12. Dentition of hypostome 3/3. Coxal spurs pointed and not notably flattened; internal spurs much smaller than the externals. Scutum smooth; ornamentation not limited primarily to the anterolateral fields; punctations scattered, unequal in size, larger in the peripheral areas. . . . . *dissimile*  
 Dentition of hypostome 4/4. Coxal spurs broadly rounded, blunt, subequal. Scutum roughened by small areas of punctation-free elevations; ornamentation limited primarily to the anterolateral fields; punctations dense, coarse and deep . . . . . *sabanerae*
13. Coxa I with two long contiguous equal or sub-equal spurs. . . . . 14  
 Coxa I with one or both spurs short or medium. . . . . 15
14. Palpal segment 1 ventrally with a broad flattened expansion; segment 2 with a pronounced salient ridge surrounding the posterior border and forming dorsally a strong retrograde spine. . . . . *nodosum*  
 Palpal segment 1 ventrally without broad expansion; segment 2 without posterior salient ridge but posterodorsal margin pointed. . . . . *calcaratum*
15. Coxa I with external spur long and pointed, the internal spur short and blunt. Festoons, except the first and median, each bearing a small posteriorly-directed tubercle. Scutum flat; punctations numerous, shallow. Small species. *naponense*  
 Coxa I with subequal spurs. . . . . 16
16. Small species; scutum less than 4.5 mm. long, indistinctly ornate; punctations numerous, small. Parasite of pacas primarily. . . . . *pacae*  
 Large species, scutum more than 4.5 mm. long. . . . . 17

17. Spurs of coxa I short, approximately as long as wide, well separated. Integument yellowish. Scutum with indistinct ornamentation and with numerous small deep punctations. Cornua very short and broad. Parasite of anteaters primarily ..... *pictum*  
 Spurs of coxa I medium, approximately twice as long as broad, contiguous. Scutum with ornamentation much reduced but distinct. Punctation numerous, coarse, absent from three or four small isolated elevated areas on each side and a similar median area. Cornua long. Parasite of sloths primarily..... *varium*

## FEMALES

1. Coxa I with equal or subequal spurs..... 2  
 Coxa I with the external spur much longer than the internal..... 14  
 2. Coxa I with long spurs, more than twice as long as broad..... 3  
 Coxa I with medium or short spurs..... 6  
 3. Coxa I with slender spurs..... 4  
 Coxa I with stout spurs..... 11  
 4. Coxa I with very long acute spurs, the external slightly curved outward near its tip ..... *ovale*  
 Coxa I with moderately long spurs, apical portion of external spur not curved... 5  
 5. Genital apron overlaid on each side posterolaterally by a conspicuous, blunt, flattened projection darker in color than the apron and adjacent integument. Punctations not limited to anterior half of scutum..... *tapirellum*  
 Genital apron overlaid on each side with an inconspicuous, long, slender projection. Punctations very scant on posterior half scutum..... *oblongoguttatum*  
 6. Coxa II-IV with two spurs (internal spur of IV sometimes absent). Parasites of reptiles and amphibians ..... 7  
 Coxa II-IV with one spur. Parasites of warm-blooded hosts..... 9  
 7. Hypostome dentition 3/3. Internal spur of coxa IV very small, sometimes absent ..... *dissimile*  
 Hypostome dentition 4/4..... 8  
 8. Very large species; scutum over 4 mm. wide. Coxae II-IV each with a pair of short rounded plate-like spurs connected by a salient sharp-edged ridge... *crassum*  
 Smaller species; scutum less than 3.5 mm. wide. Spurs of coxae II-IV distinctly separated ..... *sabanerae*  
 9. Large species; scutum approximately 3 mm. wide; punctations numerous, coarse or medium. Basis capituli with cornua. Hypostome dentition 4/4..... 10  
 Small species; scutum approximately 2 mm. wide; punctations numerous, fine. Cornua absent. Hypostome dentition 3/3..... *auricularium*  
 10. Spurs of coxa I short, about as long as wide. Scutum with punctations medium in size, uniformly distributed. Parasite of anteaters primarily..... *pictum*  
 Spurs of coxa I about twice as long as wide. Scutum with large deep punctations, these usually few or absent from median field near posterior margin. Parasite of sloths primarily..... *varium*  
 11. Scutum with extensive pale ornamentation. Palpal segment 1 ventrally with a large elongate flattened plate..... *coelebs*  
 Scutum extensively dark-colored..... 12  
 12. Scutum inornate or indistinctly ornate. Coxa I with external spur the longer... *pacae*  
 Scutum usually distinctly ornate. Coxa I with spurs equal..... 13  
 13. Scutum with ornamentation consisting of an irregular pale spot in the posterior angle and sometimes one also in each posterolateral field. Palpi slender and smooth ..... *calcaratum*  
 Scutum with ornamentation in the form of a pale spot in the posterior angle and a Y-shaped figure in each lateral field. Palpi heavier and more rugose, segment 2 with an oblique ridge dorsally..... *nodosum*  
 14. Scutum ornate ..... 15  
 Scutum inornate; small, about 1.5 mm. wide..... *parvum*

15. Coxae II and III with broad flat ridge-like spurs much broader than long.....16  
 Coxae II and III with spurs scarcely broader than long.....17
16. Palpal segment 2 about two and one-half times as long as segment 3. Fестоons ventrally somewhat rugose and poorly defined, first four on each side of the median each with a well-developed tubercle at the posterointernal angle. Internal spur of coxa I broad, blunt .....*pecarium*  
 Palpal segment 2 about twice as long as segment 3. Fестоons ventrally smooth and clearly defined, each except the median, with a much smaller tubercle at the posterointernal angle. Internal spur of coxa I narrower and more sharply pointed .....*cajennense*
17. A small to medium-sized species. Coxa I with external spur long, slender, pointed; internal spur, short, blunt, stout. Scutum with extensive pale ornamentation .....*naponense*  
 Large species. Coxa I with both spurs short, flat; internal spur very small. Scutum mostly dark colored.....18
18. Scutum cordiform, about as long as wide, with irregular pale areas in the postero-median field .....*geayi*  
 Scutum elongate oval, indistinctly ornate with an irregular longitudinal pale area in the median field. Hypostome very long and sharply pointed. Legs, especially IV, notably long .....*longirostre*

### **Amblyomma auricularium (Conil)**

- Ixodes auricularius* Conil, 1878, Act. Acad. Nac. Cienc. Exact., 3: 99-110, figs.  
*Amblyomma concolor* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 222. Robinson, 1926, Ticks, pt. 4, pp. 66-69, figs.  
*Amblyomma auricularium* (Conil), Lahille, 1905, An. Minist. Agric., Secc. Zootec. Bact., Vet., Zool., 2, (2), pp. 34, 145-148, figs. Aragão, 1935, Mem. Inst. Osw. Cruz, 30, (3), p. 528 (with *A. concolor* as synonym). Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), pp. 583-584.  
*Amblyomma curruca* Schulze, 1936, Zeitschr. Parasitenk., 8, (6), pp. 621-622. *New synonymy*.

This is an abundant species whose chief hosts appear to be armadillos, although it has been taken in smaller numbers on a variety of other mammals, especially marsupials and edentates. It appears to range throughout the Republic, though most of our records are from the drier Pacific side and all are from elevations below 500 feet. We have specimens from the following hosts: *Dasypus novemcinctus* (22 lots, 164 males, 122 females, 28 nymphs, 7 larvae); *Cabassous centralis* (1 lot, 1 male, 2 nymphs); *Tamandua tetradactyla* (12 lots, 14 males, 13 females); *Didelphis marsupialis* (2 lots, 3 males, 1 female); *Philander opossum* (3 lots, 4 males, 4 females, 13 nymphs, 5 larvae); *Sigmodon hispidus* (2 lots, 2 females reared from 2 nymphs); *Hydrochaeris hydrochaeris* (1 lot, 1 male); *Nasua nasua* (1 lot, 2 males); domestic dog (1 lot, 1 male); animal burrows, probably dug by armadillos (2 lots, 1 male, 1 female, many nymphs). The three lots from *Philander* consisted, in part, of engorged nymphs from which adults were reared.

The range of this species extends from Mexico to Argentina.

Examination of the types of *A. curruca* by Kohls revealed that this species is a synonym of *A. auricularium*, not of *A. parvum* as stated by Aragão and Fonseca (1953).

**Amblyomma cajennense** (Fabricius)

*Acarus cajennensis* Fabricius, 1787, Mant. Insect., p. 372.

*Amblyomma cajennense* (Fabricius), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 96; 1934, Psyche, 41, (3), p. 182; 1934, Jour. Parasit., 20, (5), p. 312. Robinson, 1926, Ticks, pt. 4, pp. 48-54, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Cooley and Kohls, 1944, Jour. Parasit., 30, (2), pp. 83-87, figs. Aragão and Fonseca, 1953, Mem. Inst. Osw. Cruz, 51: 485-488. Kohls, 1958, Jour. Parasit., 44, (4), pp. 430-433, figs.

Although this is an abundant species, it is interesting that adults are not often taken from wild hosts. Our records, therefore, do not adequately indicate its abundance, since collections from domestic animals have been few and confined to small samples of the population of ticks on any one animal. For this reason no numbers of ticks collected are given below in the host list. The species seems to be present in most parts of the country up to elevations of over 5000 feet, but is most abundant in the drier areas and where cultivation has reduced the original forest cover. Our records are, as with most species of *Amblyomma*, confined almost wholly to adults, as nymphs and larvae are not yet identifiable with certainty: Horse (24 lots), cattle (20 lots), man (13 lots), dog (5 lots), horse-baited mosquito traps (3 lots), *Tamandua* (3 lots), *Didelphis* (2 lots), deer (2 lots), domestic hog (2 lots), chicken (2 lots), on vegetation and ground (2 lots), tapir, peccary, *Dasyapus*, goat and a hawk, *Buteo magnirostris* (1 lot each). As can be seen by the above, horses and cattle seem to be the preferred hosts of the adults. Most of the collections from man consist of one or a few specimens taken crawling on the clothing, though the species will attack if given the opportunity. It is probably the larvae of this species which form the bulk of the seed ticks which attack man in enormous numbers during the dry season.

The range of *A. cajennense* extends from southern Texas and islands of the Caribbean to Argentina. In Panama, natural infection of this tick with the etiologic agent of Rocky Mountain spotted fever, *Rickettsia rickettsi*, has been demonstrated by Rodaniche (1953) and the species is believed to be a vector here as in Mexico, Colombia and Brazil.

**Amblyomma calcaratum** Neumann

*Amblyomma calcaratum* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 226. Robinson, 1926, Ticks, pt. 4, pp. 191-194, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584.

This large tick is almost restricted to anteaters; of 24 lots, 20 are from *Tamandua tetradactyla* and one from *Myrmecophaga tridactyla*, the latter a rare animal in Panama. Two of the remaining lots, collected by L. H. Dunn from *Choloepus hoffmanni*, include 5 adults, Panamá, and 1 female from Río Abajo (Panamá), 28 Sept. 1931. One lot is from *Mazama americana*, 1 male, Río Teribe (Bocas del Toro), 10 Aug. 1962. We have studied 62 males, 24 females, from localities on both coasts and from Darién to Bocas del Toro Provinces, but not from any elevations over 2500 feet. This species is often found together with *A. nodosum* on the same animal, and has a similar geographic range in Panama.

In addition to Panama, this species has been recorded from Venezuela, French Guiana, Ecuador, Brazil, and Paraguay. The Rocky Mountain Laboratory collection contains 1 male, San Rafael, Trinidad, 27 Feb. 1947, from *Tamandua tetradactyla longicauda*, Frank Wonder, Chicago Natural History Museum; 5 males, Río Guapaya, La Macarena (Meta), Colombia, 21 March 1957, from *Tamandua* sp., K. von Sneidern, Chicago Natural History Museum; 1 male, 1 female, San José, Costa Rica, 5 Feb. 1934, from "small anteater", F. Nevermann; 7 males, 2 females, Kate's Lagoon, British Honduras, 26 Feb. 1940, from "lesser anteater", I. T. Sanderson, Chicago Natural History Museum.

### *Amblyomma coelebs* Neumann

*Amblyomma coelebs* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 223. Robinson, 1926, Ticks, pt. 4, pp. 30-33. Dunn, 1934, Jour. Parasit., 20, (5), p. 312; Psyche, 41, (3), p. 182. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Dias, 1958, An. Inst. Med. Trop., 15, (2), pp. 507-508 (with *A. bispinosum* Neumann as synonym). *Amblyomma bispinosum* Neumann, 1906, Arch. Parasit., 10, (2), p. 204.

Dunn (1934, 1934a) recorded this species from tapir and horse, Progreso (Chiriquí), and from three tapirs from Summit (Canal Zone), and Aguas Buenas (Panamá). Fairchild (1943) added records of single specimens from tapir and horse. Subsequent records, mostly from tapir, are as follows: Cerro Azul (Panamá), 12 May 1957, GML, from tapir, 1 female and 4 nymphs presumably this species; Río Chico Hydrographic Station, Upper Río Chagres (Panamá), 20 March 1948, GML, from tapir, 8 males, 2 females; Río Tuirá at mouth of Río Paya (Darién), 25 Feb. 1958, P. Galindo, from *Agouti paca*, 1 female; same locality, 3 July 1958, P. Galindo, no host, free; Río Mandinga (San Blas), 18 May 1957, GML, no host, free; Río Changena (Bocas del Toro), 2400 feet, 2 Aug. 1961, R. Hartmann, from tapir, 5 males; same locality 16 Sept. 1961, C. M. Keenan and C. E. Yunker, from tapir, 1 male; Río Teribe (Bocas del Toro), 10 Aug. 1962, GML, 6 males, 6 females, from *Tapirus bairdii*; Porto Bello Trail, Continental Divide (Panamá), 30 May 1914, Hallinan, no host, 1 female; Barro Colorado Island (Canal Zone), 30 March 1924, in woods, no host, 3 females.

The range of this species extends from Mexico to Brazil and northern Argentina. In addition to hosts mentioned above, we have seen specimens from *Mazama americana* in Mexico and from cattle in Nicaragua.

### *Amblyomma crassum* Robinson

*Amblyomma crassum* Robinson, 1926, Ticks, pt. 4, pp. 177-179, figs. Osorno-Mesa, 1941, An. Acad. Nac. Med., 1938-40, pp. 413, 422, 425-426. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Mendez and Ortiz, 1957, Mem. Soc. Cienc. Nat. LaSalle, 17: 190-199, figs. Dias-Ungria, 1957, Rev. Sanid. Asist. Social, 22, (5-6), p. 459. Dias, 1958, An. Inst. Trop. Med., 15, (3), pp. 496-497 (as synonym of *A. humerale* Koch).

Although we have not taken this species in Panama, we include it because it was described from "Darién Country, Colombia," which may have been within the present boundaries of Panama. The description was based on a female found on a "land-tortoise". Available specimens recorded by Fair-

child (1943) as this species or *sabanerae* Stoll or *humerale* Koch prove to be *sabanerae*, and there are as yet no authentic records of the occurrence of either *crassum* or *humerale* in Panama.

Mendez and Ortiz (1957) described the male and redescribed the female which they believed to be *crassum* found on "land-tortoise (*Testudo* sp.)" from the territory of the Delta Amacuro in Venezuela but their descriptions and figures appear to be those of another species, perhaps *sabanerae*. Osorno-Mesa (1941) included both sexes in his key and recorded males from land turtles taken in two localities in Intendencia del Meta, Colombia. Dias-Ungria (1957) recorded specimens from *Testudo* sp. in Venezuela. The Rocky Mountain Laboratory collection contains a female taken from "*Testudo tabulata*" (= *Geochelone* sp.), Unguía, Golfo de Urabá, Chocó, Colombia, March, 1950, P. Hershkovitz, Chicago Natural History Museum; and a female found on a log, Sheshea River Basin at the headwaters of the Peruvian Amazon, Peru, 1960 or 1961, by G. E. Dickinson and received from Dr. R. E. Ryckman of Loma Linda University, Loma Linda, California.

### **Amblyomma dissimile** Koch

*Amblyomma dissimile* Koch, 1844, Arch. Naturg., 10: 225. Dunn, 1918, Jour. Parasit., 5, (1), pp. 1-10; 1923, Amer. Jour. Trop. Med., 3, (2), p. 97. Robinson, 1926, Ticks, pt. 4, pp. 163-167. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Cooley and Kohls, 1944, Jour. Parasit., 30, (2), pp. 98-102, figs. Aragão and Fonseca, 1953, Mem. Inst. Osw. Cruz, 51: 489 (with *A. deminutivum* Neumann, 1899 as synonym). Dias, 1958, An. Inst. Med. Trop., 15, (2), pp. 494-496 [as synonym of *A. bibroni* (Gervais), 1842].

This is the common reptile tick in Panama. Dunn (1923) found that over 60 percent of the snakes, 72 percent of the toads and 84 percent of the iguana lizards he examined were infested. Dunn (1918) also made a study of the life history of this tick. Fairchild (1943) noted that laboratory infestations on captive snakes were severe enough to kill the snakes. In one case, 190 ticks were removed from a single small fer-de-lance (*Bothrops atrox*). Tipton more recently secured 1800 ticks of all stages from a single snake. All stages are frequently found on a single host animal. The bulk of our material has come from the Canal Zone and vicinity, with no specimens from elevations over 800 feet. We have about 95 lots containing adults, mostly from snakes and iguanas, and an additional 22 lots of nymphs and/or larvae, mostly from lizards, which are probably this species. Two unusual records are 1 male, 1 nymph, 2 larvae from a hatchling aquatic turtle, *Pseudemys scripta*, Barro Colorado Island, Canal Zone, 20 Aug. 1961, J. M. Legler, and 1 male from boat-billed heron, *Cochlearius cochlearius*, Juan Mina, Chagres River, 5 April 1962, C. L. Hayward.

The range of this species extends from Florida, Mexico, and the West Indies, to Argentina.

Dias (1958) maintains that Neumann's (1899) summary of the Gervais (1842) and Packard (1869) descriptions of *Ixodes bibroni* applies to *A. dissimile* but we prefer to retain *dissimile* as the valid name of this species.

**Amblyomma geayi** Neumann

*Amblyomma geayi* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 223–224; 1901, Mém. Soc. Zool. Fr., 14: 299. Robinson, 1926, Ticks, pt. 4, pp. 59–61, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Dias, 1961, An. Serv. Veter. Moçambique, 7: 240–242 [as synonym of *A. perpunctatum* (Packard), 1869].

We have secured some 60 lots of this species, practically all from our two species of sloth, *Bradypus infuscatus*, the three-toed sloth, and *Choloepus hoffmanni*, the two-toed sloth. The former is much more often seen, as it feeds on the foliage of the Guarumo (*Cecropia pentandra*) a common second-growth tree in the Canal Zone and elsewhere in the lowlands of Panama. Sloths are frequently encountered crossing highways and are then easily captured, or their corpses may be searched for ticks. However, they are seldom seen and difficult to secure in less inhabited areas, since they are hard to collect from the tree tops. This we believe accounts for the fact that with the exception of three lots from Bocas del Toro Province, all our material is from the Canal Zone or immediate vicinity. We have 35 lots from *Bradypus*, 227 males, 36 females, 8 nymphs; 12 lots from *Choloepus*, 36 males, 12 females; and 8 lots from unidentified sloths, 47 males, 8 females, 2 nymphs, 1 larva. In addition we have a single nymph from the woolly opossum, *Caluromys derbianus*, and 2 males, 1 female, said to be from "Eaton's opossum", which may refer to *Didelphis marsupialis etensis*. The remaining lots are without host, but are probably from sloths. Nymphs, possibly of this species, are occasionally taken with adults on sloths.

This species, originally described from specimens from Brazil and "Darien (Colombie)" which may have been within the present boundaries of Panama, is also recorded from British Guiana and French Guiana. In addition, the Rocky Mountain Laboratory collection contains specimens from *Choloepus*, Iquitos (Loreto), Peru, Sept. 3, 1956, C. Kalinowski, Chicago Natural History Museum.

After reviewing the literature, Dias (1961) concluded that *A. geayi* is the species that was very inadequately described by Packard (1869) as *Ixodes perpunctatus*. We cannot accept his conclusion and we regard *A. geayi* as the valid name of this species.

**Amblyomma longirostre** (Koch)

*Haemalastor longirostris* Koch, 1844, Arch. Naturg., 10, (1), p. 223.

*Amblyomma longirostre* (Koch), Robinson, 1926, Ticks, pt. 4, pp. 137–140, figs., synonymy. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 585.

*Amblyomma avecolens* Cooley and Kohls, 1944, Jour. Parasit., 30, (2), pp. 107–109, figs. *New synonymy*.

This species appears to be a specific parasite of porcupines, all our records of adults and those of Dunn (1923) being from *Coendou rothschildi*. The males are sometimes found attached to the spines of the host as noted by some earlier workers. Aragão (1936) says that the larvae and generally the nymphs are parasites of birds, and we have nymphs from seven species of birds in Panama. We have records only from the Canal Zone and Darién Province, listed below, but porcupines are uncommon or at least seldom

taken, so that we know little of the distribution of either host or tick in Panama. It is noteworthy that a series of the highland porcupine, *Coendou mexicanus*, was not infested with this tick, but with *Dermacentor halli*.

From the Canal Zone: Gatún, 2 Jan. 1932, L. H. Dunn, 1 male, 1 nymph; Juan Mina, 24 April 1940, GML, 2 females; Fort Sherman, 30 July 1959, V. J. Tipton and C. M. Keenan, 1 male, 1 female; same locality and collectors, 29 July 1960, 1 female; same locality, F. S. Blanton, 29 June 1951, 1 male; Curundu, 10 March 1961, V. J. Tipton and C. M. Keenan, 5 males, 1 female; same locality, 19 April 1962, C. E. Yunker, 1 male; Pedro Miguel River, 28 Feb. 1962, V. J. Tipton, 9 males; Barro Colorado Island, 4 March 1955, C. Rettenmeyer, without host data, 1 female, Kansas University 955. Of nymphs, we have records from the following: *Saltator albicollis*, *Saltator maximus*, *Icterus chrysater*, *Xiphorhynchus* sp., *Malacoptila panamensis*, *Cymbilaimus lineatus*, *Cacicus microrhynchus* and *Querula purpurata*, all but one belonging to the Passeriformes. Five of the 12 lots of nymphs were from the vicinity of Cerro Pirre (Darién), at about 1600 feet, the rest from Canal Zone localities. Some of the undetermined nymphs and larvae from birds discussed elsewhere in this paper may also be *longirostre*.

The known breeding range of this species, as evidenced by collections of adults, extends from Panama to Brazil but nymphs are found occasionally on birds as far north as the United States. The Rocky Mountain Laboratory collection contains nymphs reported by Cooley and Kohls (1944) as *avecolens* from British Honduras and southern Texas, as well as a nymph taken off the base of the bill of a cardinal at Nashville, Tennessee, 17 July 1947, and several nymphs from birds in Chiapas, Mexico. Kohls has seen a nymph that was found on the throat of a white-eyed vireo in Leon County, Florida, 2 April 1957, L. J. Stannard, Illinois Natural History Survey.

### **Amblyomma naponense (Packard)**

*Ixodes naponensis* Packard, 1869, Ann. Rept. Peabody Acad. Sci., p. 65.

*Amblyomma naponense* (Packard), Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 99.

Osorno-Mesa, 1941, An. Acad. Nac. Med., 1938-1940: 426 (with *A. mantiquirensis* Aragão, 1908 as synonym). Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 585.

*Amblyomma mantiquirensis* Aragão, 1908, Brazil. Med., 22: 251-252. Robinson, 1926, Ticks, pt. 4, pp. 212-215, figs. Dunn, 1934, Psyche, 41, (3), p. 182.

Dunn (1923, 1934) records the species from *Tamandua* and collared peccary. Our collections, with few exceptions, are from collared peccary and are summarized as follows: *Tayassu tajacu* (13 lots, 11 males, 27 females); no host (3 lots, 6 males, 2 females); man (1 lot, 1 male, 1 female); *Tamandua tetradactyla* (1 lot, 1 female); *Nasua nasua* (1 lot, 2 females); raccoon (1 lot, 1 female). This species appears to prefer the wetter areas of Panama, as we have material only from the Provinces of Darién, San Blas, Colón, Bocas del Toro and the Canal Zone. Only two collections, from Balboa and Fort Clayton in the Canal Zone, are from relatively dry areas. Only one collection was made above 2000 feet.

This species has also been recorded (as *mantiquirensis*) from British

Guiana, French Guiana, and Brazil. The Rocky Mountain Laboratory collection contains specimens from *Tayassu tajacu*, Socorré, Upper Río Sinú (Bolívar), Colombia, 12 March 1949, P. Hershkovitz, Chicago Natural History Museum; and from "wild pig", Sheshea River basin at the head of the Peruvian Amazon, Peru, 1960 or 1961, G. E. Dickinson, received from Dr. R. E. Ryckman, Loma Linda University, Loma Linda, Calif.

### **Amblyomma nodosum** Neumann

*Amblyomma nodosum* Neumann, 1899, Mém. Soc. Zool. Fr., 12: 224-225. Dunn, 1923, Amer. Jour. Trop. Med., 3, (2), p. 98. Robinson, 1926, Ticks, pt. 4, pp. 196-199, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 585.

This species is rather easily confused with *A. calcaratum*, as the two are quite similar in gross appearance and both occur on the same host, often together. We have 19 lots from *Tamandua tetradactyla*, one lot from *Myrmecophaga tridactyla*, and one lot from unknown host, totaling 207 males, 48 females, of which 95 males, 13 females came from one animal. It occurs throughout the lowlands, including at least San José Island in the Pearl Islands, but we have no records from elevations over 1000 feet.

This species, the adults of which are parasitic only on anteaters so far as known, was described from specimens from Costa Rica and besides Panama, it has also been recorded from Guatemala, Colombia, Venezuela, and Brazil. The Rocky Mountain Laboratory collection contains 1 male, 2 females from "lesser anteater", El Recreo, Nicaragua, 9 Feb. 1951, W. H. Dickinson.

### **Amblyomma oblongoguttatum** Koch

*Amblyomma oblongoguttatum* Koch, 1844, Arch. Naturg., 10: 228. Robinson, 1926, Ticks, pt. 4, pp. 33-36, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 585. Kohls, 1958, Jour. Parasit., 44, (4), pp. 430-433.

This is probably the commonest and most ubiquitous tick in Panama, at least at lower elevations. Our records indicate that it prefers forested country, or at least areas of moderately high rainfall, since we have relatively few records of its occurrence in the drier areas of the Pacific coast. Dunn (1923) records it, as *darlingi*, from wild turkey, *Crax panamensis* (*Crax rubra*) from the Boquerón River region and from a black vulture, *Catharista urubu* (= *Coragyps atratus*), while Robinson (1926) records specimens from a turkey buzzard, *Catharista atratus* (= *Coragyps atratus*) from Empire (Canal Zone). We have examined 131 lots of adults from 21 different mammal hosts listed below.

Deer (*Odocoileus*) (18 lots); horse (17 lots); cattle (15 lots); dog (19 lots); peccary (13 lots); man (9 lots); *Nasua nasua* (10 lots); *Tamandua tetradactyla* (7 lots); tapir (7 lots); no host, free on vegetation, etc. (12 lots); domestic hog (3 lots); *Mazama* (2 lots); *Dasyprocta* (3 lots); sloth (*Choloepus*), *Myrmecophaga tridactyla*, goat, armadillo, *Procyon cancrivorus*, *Chironectes minimus*, *Cebus capuchinus*, *Eira barbara*, and domestic cat, (1 lot each).

According to Robinson (1926) and data of the Rocky Mountain Laboratory, *A. oblongoguttatum* occurs from Sinaloa, Mexico to Brazil. The species

strongly resembles *A. cajennense* (Fabricius) and *A. tapirellum* Dunn but is separated by the characters given in the keys.

### **Amblyomma ovale** Koch

*Amblyomma ovale* Koch, 1844, Arch. Naturg., 10: 227. Robinson, 1926, Ticks, pt. 4, pp. 25–29, figs. (with synonyms including *A. fossum* Neumann, 1899, and *A. striatum* Koch, 1844). Vogelsang and Dias, 1953, Revista Med. Vet. Parasit., Caracas, 12, (1–4), pp. 70–74, figs. (with synonyms including *A. fossum*). Dias, 1958, An. Inst. Med. Trop., 15, (2), p. 507 (with *A. fossum* as synonym). Aragão and Fonseca, 1961, Mem. Inst. Osw. Cruz, 59, (2), pp. 131–148, figs. (detailed review of synonymy; redescribed).

This tick ranges throughout the wetter forested regions of Panama at lower elevations, and we have one record from San José Island in Panama Bay. Dunn (1923, 1934) records specimens from *Tamandua* and tapir, while Fairchild (1943) believed dogs to be the most common host. We have examined 39 lots of adults from 16 different hosts, listed below in order of their abundance. One of the largest single lots, consisting of 17 males and 9 females, was from *Nasua nasua*, which also seems to be a favorite wild host. Over 60 percent of the recorded lots and over 80 percent of the total ticks were from carnivores.

*Nasua nasua* (12 lots, 44 males, 15 females); dog (9 lots, 14 males, 10 females); man (7 lots, 5 males, 4 females); tapir (6 lots, 13 males, 11 females); *Felis pardalis* (3 lots, 1 male, 2 females); *Eira barbara* (3 lots, 11 males, 4 females); horse (2 lots, 1 male, 1 female); *Oryzomys* sp. (2 lots, 2 males); *Felis concolor* (1 lot, 25 males, 1 female); *Felis onca* (1 lot, 2 males, 1 female); sloth (1 lot, 2 males); *Felis yagouaroundi* (1 lot, 1 male, 1 female); *Procyon lotor* (1 lot, 1 male, 1 female); and one specimen each from *Procyon cancrivorus*, armadillo, *Galictis allamandi*, and a bird, *Arremonops conirostris*.

Engorged nymphs which subsequently molted to adults have been taken four times from *Proechimys semispinosus*, and once from *Zygodontomys microtinus*, so that rodents are perhaps important hosts for the earlier stages. Nymphs and larvae associated with adults on the same host, taken on several occasions, are not certainly *ovale*.

Several authors refer to this species as *A. fossum* Neumann, 1899, despite the fact that Robinson (1926) compared numerous specimens of *fossum* from various places in South America with the types of *ovale* and found them to be the same. Dias (1958) examined the types of *fossum* and, in accordance with Robinson and Vogelsang and Dias (1953), found that this species is the same as *ovale*. Although Robinson also reduced *striatum* Koch, 1844, to a synonym of *ovale*, he noted that *striatum* differed somewhat but attributed this to variation. Most subsequent authors have regarded *striatum* as distinct, the most recent of these being Aragão and Fonseca (1961) who include *fossum* among the synonyms of *ovale* and recognize *aureolatum* Pallas, 1772, as the valid name for *striatum*. We have not seen specimens referable to *aureolatum* in our Panama material but a male from an unspecified locality in Darién, possibly within the present boundaries of Panama, was doubtfully determined by Neumann (1899) as *striatum*.

The range of *ovale* extends from Mexico to Argentina. A single male was removed from a dog on the Tama Indian Reservation in Iowa (Eddy and Joyce, 1942) but there is no evidence to suggest that the species is established there or elsewhere in the United States.

### *Amblyomma paca* Aragão

*Amblyomma paca* Aragão, 1911, Mem. Inst. Osw. Cruz, 3, (2), pp. 170-172, figs. Robinson, 1926, Ticks, pt. 4, pp. 209-211, figs. Aragão and Fonseca, 1953, Mem. Inst. Osw. Cruz, 51: 490 (with *A. nigrum* Tonelli Rondelli, 1939 as synonym).

Fairchild (1943) tentatively recorded this species from *Agouti paca*, a determination subsequently confirmed by Kohls. Since then, in spite of the ubiquity and abundance of its hosts, only a few additional collections of this species have been secured, as follows: Almirante (Bocas del Toro), 26 Jan. 1950, V. J. Tipton and C. M. Keenan, from *Agouti paca*, 1 female; Volcán (Chiriquí), 15 June 1959, V. J. Tipton and C. M. Keenan, from *Dasyprocta punctata*, 3 males, 3 females; vicinity of Juan Mina (Canal Zone), Jan. 1962, GML, from *Agouti paca*, 1 female; Fort Kobbe (Canal Zone), 18 Aug. 1955, G. Field, from *paca*, 1 female; Panamá, L. H. Dunn, T-12, no other data, 1 female; Timishik, Rio Teribe (Bocas del Toro), May 1962, GML, from *Agouti paca*, 1 female.

In addition to Panama this species is recorded from Brazil, Paraguay and Colombia, and the Rocky Mountain Laboratory collection contains a male from *Agouti paca*, Humming Bird Highway, British Honduras, 25 Dec. 1953, Dr. F. Manolson.

### *Amblyomma parvum* Aragão

*Amblyomma parvum* Aragão, 1908, Trab. Inst. Manguinhos, pp. 18-19 (reprint). Robinson, 1926, Ticks, pt. 4, pp. 37-38. Aragão and Fonseca, 1953, Mem. Inst. Osw. Cruz, 51: 491 [with *A. curruca* Schulze, 1936, erroneously as synonym. Actually, *A. curruca* = *A. auricularium* (Conil), 1878].

This appears to be a rare species in Panama. Dunn (1923) recorded it from deer (*Odocoileus*) and cotton rats (*Sigmodon*) and Fairchild (1943) added a single record from cattle. Review of some old material of Dunn's and a few additional lots taken more recently suggests that the species occurs mainly on the drier Pacific coast and that we do not know its favored host. Our scanty records follow:

Parita (Herrera), 13 June 1931, L. H. Dunn, from cats, 3 females; Tumba Muerta (? Panamá), 13 Sept. 1932, L. H. Dunn, from *Tamandua*, 1 female; Coclé Province, 3 Dec. 1942, H. S. Eakins, from cattle, 1 male, 1 female; Balboa (Canal Zone), 8 Dec. 1914, no host, American Museum of Natural History, 1 female; Paraíso (Canal Zone), May 1955, G. Field, from sloth, 1 female; Fort Clayton (Canal Zone), 7 Nov. 1960, C. E. Yunker, from man, attached, feeding, 1 female.

Besides Panama, this species has been recorded from a wide variety of mammalian hosts from Venezuela, French Guiana, Brazil, and Argentina. In addition, the Rocky Mountain Laboratory collection contains a male and a female taken on man, Finca Santa Cristina (Escuintla), Guatemala, 10 Sept. 1948, H. T. Dalmat, and 3 males from *Urocyon cinereoargenteus*

*guatemalae*, Hacienda Miramar (Nentón), Guatemala, 18 Nov. 1948, L. de la Torre, Chicago Natural History Museum. Excellent illustrations of adults of this tick are given by Boero (1957).

### **Amblyomma pecarium** Dunn

*Amblyomma pecarium* Dunn, 1933, Parasitology, 25, (3), pp. 356-358, figs.

Three male paratypes in bad condition remain at Gorgas Memorial Laboratory labeled Miraflores (Canal Zone), 11 Apr. 1932, R. Isaacs, Dunn no. 859, from *Pecari angulatus bangsi*. We have seen the following material, all from collared peccary, or wild pig, very probably collared peccary: Almirante (Bocas del Toro), 9 Feb. 1960, V. J. Tipton and C. M. Keenan, 1 male; Río Tuira, mouth of Río Paya (Darién), 28 Feb. 1958, GML, 1 male; Juan Mina (Canal Zone) 29 March 1946, many males, females, and nymphs; Almirante (Bocas del Toro), 1 March 1937, United Fruit Company Medical Department, 2 males; Fort Clayton (Canal Zone), 13 Sept. 1954, G. Field, 18 males, 1 female; Barro Colorado Island (Canal Zone), 2 Feb. 1961, C. E. Yunker, 7 males, 4 females.

The Rocky Mountain Laboratory collection contains a female from "peccary", Humming Bird Highway, British Honduras, 25 Dec. 1953, F. Manolson, and three lots from jungles of El Ocote, Ocozocautla (Chiapas), Mexico, Miguel Alvarez del Toro, with data as follows: 7 males, 1 female from *Tayassu tajacu*, 4 May 1946; about 40 adults from *Tayassu pecari*, 4 May 1946; and 19 males, 12 females from *Mazama americana*, 25 May 1950. Whether this last lot is actually from a deer seems questionable since all other collections of *pecarium* are from peccaries.

### **Amblyomma pictum** Neumann

*Amblyomma pictum* Neumann, 1906, Arch. Parasit., 10, (2), pp. 204-206. Robinson, 1926, Ticks, pt. 4, pp. 238-240 (with *A. conspicuum* Aragão, 1913, as synonym).

A single female which appears to be this little-known species was found on an anteater, *Myrmecophaga tridactyla*, Río Mandinga (San Blas), 25 May 1957, P. Galindo. This species has been previously reported from Brazil off *Myrmecophaga tridactyla* (= *Myrmecophaga jubata*) and dog; from Argentina off dog though not included in Boero's (1957) list; and from French Guiana off *Tamandua* sp. The Rocky Mountain Laboratory collection contains one of two males from giant anteater, upper New River (tributary of Courentyne), southern British Guiana, Sept. 1938, E. R. Blake, Chicago Natural History Museum. The dentition of the hypostome of these males is  $\frac{3}{8}$ , not  $\frac{1}{4}$  as stated by Neumann for this species. Aragão (1913) gave it as  $\frac{3}{8}$  in his description of *A. conspicuum*; Floch and Fauran (1958) gave it as  $\frac{3}{8}$  for their single male from French Guiana.

### **Amblyomma sabanerae** Stoll

*Amblyomma sabanerae* Stoll, 1890, Biol. Centr.-Amer., Arach., p. 23, figs. (female). Robinson, 1926, Ticks, pt. 4, pp. 182-183, figs. Schulze, 1937, Zeitsch. Parasitenk.,

9, (6), pp. 692-694, fig. (male). Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), p. 584. Dias, 1958, An. Inst. Trop. Med., 15, (2), pp. 496-497 (as synonym of *A. humerale* Koch).

Dunn (1923) recorded as *A. humerale* Koch, 2 males, 2 females taken from a tortoise (which he believed to be *Testudo tabulata*) on the Boqueron River (Panamá), H. C. Clark. Later (1934) he recorded as *humerale* a single adult, sex not stated, from a tapir. We have not seen Dunn's specimens from *Testudo* but we have a *sabanerae* male, without data, determined by Bishopp as *humerale*, which may well be the specimen Dunn reported from tapir. Recent examination of specimens of *Geochelone* (= *Testudo*) from the San Blas coast did not yield any ticks, though several *sabanerae* were taken from specimens of *Geoemyda* from the same area. Whether ticks from *Geochelone* in Panama will be *humerale*, *crassum* (q.v.), or *sabanerae*, must await re-examination of Dunn's specimens or the collection of new material.

We have taken *A. sabanerae* fairly frequently on turtles of the genus *Geoemyda*, less frequently on other turtles and on iguanas and once on an opossum. The ticks are often attached on the carapace around the margin where they leave characteristic pits in the shell, recognizable for a considerable period after the ticks have detached. Males outnumber females about three to one in our collections, perhaps due to their remaining attached longer. Adults may attach on the shell or on the skin of head and appendages. Dr. John M. Legler informs us that *Geoemyda annulata* is largely terrestrial, *G. funeria*, *Kinosternon* spp. and *Pseudemys scripta* are aquatic, at least as adults, although they come on land to lay their eggs or when moving from one body of water to another. Most of our material has come from the vicinity of the Canal Zone, though the species appears to range throughout the country at low elevations, as we have material from Darién and Bocas del Toro Provinces.

In the subjoined list, the lots under "turtle" and *Geoemyda* sp. probably are largely from *G. annulata*, the commonest terrestrial turtle in this area. *Geoemyda annulata* (6 lots, 23 males, 4 females, 1 larva); *Geoemyda funeria* (2 lots, 6 males, 3 females, 3 nymphs, 11 larvae); *Geoemyda* sp. (6 lots, 21 males, 3 females, 3 nymphs); turtle (12 lots, 40 males, 15 females, 4 nymphs, 76 larvae); *Pseudemys scripta* (juveniles, 2 lots, 2 males); *Kinosternon* sp. (4 nymphs); *Iguana iguana* (2 lots, 7 males, 1 female); *Marmosa robinsoni* (1 male); crawling on man (1 female).

We have also seen 1 female and 2 nymphs from Los Diamantes, vicinity of Guápiles (Limón), Costa Rica, 29 July 1961, J. M. Legler, from *Geoemyda funeria* (juvenile); 1 nymph, Río Sucio, Quezaltepeque, El Salvador, 4 July 1961, J. M. Legler, from *Geoemyda pulcherina*; and the Rocky Mountain Laboratory collection has 3 records from Mexico as follows: 1 male, 1 female from Island of Cozumal, Quintana Roo, 16 July 1951, L. J. Stannard, from *Geoemyda areolata*; 2 males from Chichen Itza (Yucatan), 24 July 1937, B. W. Andrews, from *Terrapene yucatanana*, and 1 male, 1 female from Nayarit, Dec. 1955, J. Cook, from *Geoemyda* sp. The types, 2 females from Guatemala, were from "a small terrapin known to the natives by the name of

la Sabanera." Schulze described the male from specimens from Colombia without further data.

Dias (1958) reduced *A. sabanerae* and *A. crassum* to synonyms of *A. humerale* but we regard them as valid species separable by characters given in the keys.

### **Amblyomma tapirellum** Dunn

*Amblyomma tapirellum* Dunn, 1933, *Parasitology*, 25, (3), pp. 353-355, figs.; 1934, *Jour. Parasit.*, 20, (5), p. 312. Fairchild, 1943, *Amer. Jour. Trop. Med.*, 23, (6), p. 586. Kohls, 1958, *Jour. Parasit.*, 44, (4), pp. 431-432.

This species was described from tapir, and we have taken it from collared peccary, giant anteater and horse as well. The bulk of our material, however, consists of specimens found crawling on man or on the ground. It appears to be quite strictly limited to forest areas below about 2500 feet, mostly from the Canal Zone eastward into Darién Province; we have only one record from western Panama (La Vaca, Chiriquí Province, 18 Feb. 1930, Dunn, from peccary, 3 males, 1 female). We did not take it on several tapirs examined in the highlands of Chiriquí and Bocas del Toro. To a certain extent it seems to replace *A. cajennense* as a human parasite in forested areas such as Barro Colorado Island, from which we have 27 lots of *tapirellum* totaling 101 specimens, but only 8 of *cajennense*, totaling 18 specimens. We have taken it only once from horse, in that case a pack animal used on a jungle field trip, and have secured no material from cattle or deer, in marked contrast to *cajennense*. We list our material below, by numbers of lots and specimens.

Free on ground or vegetation (11 lots, 11 males, 21 females); man, on clothing (14 lots, 22 males, 32 females); collared peccary (5 lots, 9 males, 5 females); tapir (5 lots, 180 males, 36 females, 1 nymph); man, attached (1 lot, 1 male); *Myrmecophaga tridactyla* (1 lot, 3 males, 2 females); horse (1 lot, 5 males, 6 females); bat (*Carollia perspicillata*) (1 lot, 1 male); no recorded host (16 lots, 20 males, 31 females plus two large lots not counted). The specimen from bat is probably a stray from the collector. One of the large lots with no host data is labeled simply "T-1", and is from Dunn's collecting. It may well be part of the paratype series. Dunn (1933) described the species from an adult tapir collected at Summit (Canal Zone) and mentions additional specimens from two young tapirs taken subsequently, but the dates of neither collection are given. Later (1934), he discusses the ticks taken from three tapirs, an adult killed at Summit (Canal Zone), and two young specimens from Aguas Buenas (Panamá), again with no dates given. In the later paper, *A. tapirellum* is listed, with a reference to the earlier paper. We suspect that both references allude to the same lots of ticks, and that T-1 refers to "Tapir No. 1" of the 1934 paper, the adult tapir from Summit.

Data of the Rocky Mountain Laboratory extend the range of *A. tapirellum* to Nicaragua, Colombia and Venezuela and add cattle to the list of hosts parasitized by this tick.

**Amblyomma varium** Koch

*Amblyomma varium* Koch, 1844, Arch. Naturg., 10: 224 (male). Neumann, 1899, Mém. Soc. Zool. Fr., 12: 246-247 (redescription of male and description of var. *albida*, Chile); 1901, Mém. Soc. Zool. Fr., 14: 304-305 (female). Robinson, 1926, Ticks, pt. 4, pp. 205-209, figs.

*Amblyomma gertschi* Cooley and Kohls, 1942, Pub. Hlth. Rept., 57, (46), pp. 1733-1735, figs. Fairchild, 1943, Amer. Jour. Trop. Med., 23, (6), pp. 584-585. New synonymy.

Robinson (1926) records specimens from Panama off *Choloepus*, as does Dunn (1923). In the adult stage, this species, like *gayi*, appears to be restricted mainly to sloths but is less abundant. Both species appear to be slightly more abundant on *Bradypus* than on *Choloepus*.

All material we have seen, except one female from Isla Bastimentos (Bocas del Toro), has come from the Canal Zone or nearby Panamá, as follows: from *Choloepus hoffmanni*, two-toed sloth (16 lots, 30 males, 9 females); *Bradypus infuscatus*, three-toed sloth (12 lots, 30 males, 9 females); from sloth (4 lots, 10 males, 2 females); no host (1 lot, 5 males); from "Eaton's opossum," probably *Didelphis m. etensis* (1 female).

This species, originally described from specimens from Brazil, has been recorded from Nicaragua, Panama, Colombia, Venezuela, the Guianas, Argentina, and Chile (var. *albida*). Vargas (1955) included it in his list of species occurring in Mexico, but its principal hosts, *Bradypus* and *Choloepus*, do not range that far northward and we doubt its presence there. The Rocky Mountain Laboratory collection contains a male and female (and reared larvae) from a sloth from near San José, Costa Rica, March 1962, J. J. Shaw; and a male said to be from "wild pig", Sheshea River basin at the headwaters of the Peruvian Amazon, Peru, 1960 or 1961, G. E. Dickinson, received from Dr. R. E. Ryckman, Loma Linda University, Loma Linda, California.

Dunn (loc. cit.) noted an engorged female of *varium* that weighed over 5 grams, the largest tick he had seen from Panama. We have two engorged females which weigh 6.4 grams each. Floch and Fauran (1958) had a specimen from French Guiana measuring 32 mm. long, 30 mm. wide and weighing 7.5 grams.

All males of *A. varium* that we have seen differ from the type of var. *albida* (Robinson, 1926, fig. 100) in being more broadly oval and in having long stout cornua as shown in fig. 2 of Cooley and Kohls (1942). Some males also have a long rather than a short spur on coxa IV. The dentition of the female hypostome is usually arranged  $\frac{1}{4}$  rather than  $\frac{3}{8}$  as stated by Robinson. In all males that we have seen it is  $\frac{3}{8}$  as given by all previous authors, except Floch and Fauran (1958) who stated that it is  $\frac{1}{4}$ .

**Host-Parasite Relationships**

We have secured ticks from most of the larger mammals that are known to occur in Panama, as well as from a number of birds and reptiles. Specific identifications of the larger host mammals are reasonably accurate; we have not attempted to identify subspecies. Many of the smaller rodents have been identified to species, but in some cases only a guess as to their generic

identity has been possible. Many of the specimens of ticks have been accompanied by only the common name of the host. Names such as "tapir," "ocelot," "jaguar," and "armadillo" permit identification to species with fair certainty. Others such as "sloth," "wild boar," "wild turkey" pose difficulties, as two or more species are referable to these names. Names such as "bird," "lizard," "turtle," "wild rat" hardly permit conjecture.

A host-parasite list is given below. The scientific names of the mammals follow Charles O. Handley's checklist, which appears elsewhere in this volume. Most of the birds have been determined by Dr. Alexander Wetmore. The turtles were identified by Dr. John M. Legler, the other reptiles by various individuals.

In the list, following the scientific name of each host we have given: (1) the number of specimens of the host from which ticks have been taken; (2) the species of ticks in order of their frequency on the host, followed by a number in parentheses indicating the number of individual host specimens that were found infested with that species. Many lots of ticks either were not accompanied by host determinations or the host was merely listed as "mouse," "bird," "lizard," etc. These have not been listed below, but they are included under the discussion of each species of tick.

Table 5 summarizes the information in the host lists. The ticks are listed by genera, with the number of species in each genus. The mammalian hosts are listed by order. The number of genera from which ticks have been secured is indicated for each order. For birds and reptiles we have shown the number of orders and genera from which ticks have been taken. Data for ticks from Amphibia (*Bufo marinus*) are not shown. The numbers in table 5 indicate the number of determined species of tick in each genus that have been taken from hosts of each order or class of animal. "A" indicates adults, "NL" nymphs and/or larvae. A query (?) indicates that nymphs or larvae probably belonging to the indicated genus, but not determined specifically, were secured from the indicated order. In the case of nymphs and larvae, it is probable that many more species were taken than indicated, but in many cases larvae and nymphs are not determinable to species, and were not always determined to genus.

Certain associations are apparent from this table. The Marsupialia are hosts to but two genera of ticks, the Edentata to but one, yet both orders are well represented in species and individuals in Panama.

In Panama, the Chiroptera exceed all other orders of mammals in number of genera and species and yet they are true hosts to ticks of only two genera. The scattered records of other genera from bats probably represent strays or errors of association.

The Primates, with the exception of man, are rarely attacked by ticks. We have never found ticks on wild primates in Panama; all of our records are from animals in captivity.

The Lagomorpha are represented in Panama only by one species of *Sylvilagus*. These rabbits are infested by two species of ticks, *Ixodes pomerantzi* and *Haemaphysalis leporispalustris*, both apparently limited to *Sylvilagus* in Panama. Larvae of several other genera have been taken occasionally on

TABLE 5. HOST PREFERENCES OF PANAMANIAN TICKS (by genera)  
(See text for detailed explanation.)

Host groups and numbers of genera from which ticks were collected:	Genera of ticks and number of species in each										
	<i>Argas</i> : 1	<i>Antricola</i> : 1	<i>Ornithodoros</i> : 7	<i>Ixodes</i> : 11	<i>Anocentor</i> : 1	<i>Dermacentor</i> : 3	<i>Rhipicephalus</i> : 1	<i>Boophilus</i> : 1	<i>Haemaphysalis</i> : 2	<i>Amblyomma</i> : 19	
	A/NL	A/NL	A/NL	A/NL	A/NL	A/NL	A/NL	A/NL	A/NL	A/NL	
Marsupialia: 6	..	..	..	5/1	..	..	..	..	..	6/2	
Insectivora: 1	..	..	..	/?	..	..	..	..	..	..	
Chiroptera: 14	..	1/1	3/4	/?	..	/1	..	..	..	2/?	
Primates (man)	..	..	2/	1/	..	2/	..	..	..	6/?	
Edentata: 7	..	..	..	/?	..	..	..	..	..	12/2	
Lagomorpha: 2	..	..	/1	1/1	..	/?	1/	..	1/1	/?	
Rodentia: 17	..	..	/1	5/2	..	1/1	1/	..	/2	6/3	
Carnivora: 11	..	..	..	3/2	..	1/	1/1	..	/1	6/	
Perissodactyla: 2	..	..	..	2/	1/1	1/	..	1/1	1/	5/2	
Artiodactyla: 5	..	..	..	2/	1/1	1/	..	1/1	1/1	7/1	
Reptilia: 15 (from 3 orders)	..	..	..	..	..	..	..	..	..	3/2	
Aves: 26 (from 8 orders)	1/1	..	/1	1/	..	..	..	..	..	3/1	

A = adults; NL = nymphs and/or larvae;  
?=Probable members of indicated genus, but of undetermined species

these rabbits. The record for *Rhipicephalus* on Lagomorpha is based on the domestic rabbit and is doubtless due to a laboratory infestation.

The Insectivora are poorly represented in Panama. Only undetermined tick larvae were secured from the few specimens of shrews examined.

The Rodentia are hosts to thirteen species of ticks belonging to six genera. However, probably the only species whose adults regularly parasitize rodents are those of *Ixodes* and *Amblyomma*, while only the earlier instars of species of the other genera listed parasitize these hosts. Again, the record of *Rhipicephalus* refers to a rodent (capybara) kept in heavily infested quarters in the laboratory.

The Carnivora are hosts to adult ticks of eleven species belonging to four genera; an additional genus is recorded only from an early instar. *Rhipicephalus* has been taken only on domestic dogs and cats in Panama and does not belong to the native fauna.

The Perissodactyla in Panama include only the horse and tapir, but together these are hosts to eleven species of six genera of ticks. The horse is host to seven species representing three genera, the tapir to nine species belonging to four genera. Of these, *Dermacentor*, *Ixodes*, and *Haemaphysalis* have been taken only on the tapir, *Anocentor* and *Boophilus* only on the horse. The Artiodactyla, with five genera positive for ticks, have yielded thirteen species belonging to six genera. We have not had the opportunity to examine the white-lipped peccary (*Tayassu*), the only large terrestrial mammal from which we have not secured ticks.

The Reptilia, in Panama, are hosts to but two species of *Amblyomma* (three, if *A. crassum* actually occurs here), one on turtles and the other on a wide variety of lizards and snakes, as well as on the common toad, *Bufo marinus*. We have not examined any of the local Crocodilia. These are almost exclusively aquatic and not likely to be infested by ticks.

The Aves are rarely hosts to adult ticks. Probably only *Argas persicus* and *Ixodes brunneus* regularly infest birds in this stage. Birds are, however, frequently attacked by larval ticks of at least one and probably several species of *Amblyomma*. Search of a few nests of birds—such as woodpeckers and toucans, which utilize treeholes—has so far not yielded any ticks.

#### Host Specificity

It is exceptional to find adults of any Panamanian species of ticks (exclusive of Argasidae), parasitizing hosts of more than one class of vertebrates. *Amblyomma dissimile* apparently is the only tick to do so regularly, since it attacks species of both Amphibia and Reptilia. Adults of *A. dissimile* and *A. cajennense* have also been taken occasionally on birds. It is very doubtful that these hosts are satisfactory or that they are regularly parasitized by these ticks. Most Panamanian Ixodidae do not regularly parasitize hosts of more than one order of vertebrates, though there are exceptions. Among those species of which we have adequate material, two species of *Ixodes* regularly parasitize mammals of more than one order. Another species has been taken once on a small marsupial, but otherwise only on rodents, while the remaining species appear to be confined to hosts of a single order. *Anocentor nitens* and *Boophilus microplis* parasitize both Artiodactyla and Perissodactyla, while *Rhipicephalus sanguineus* is almost restricted to dogs. It is probable that all three species of *Dermacentor* regularly parasitize species of but a single order of mammals. However, all have been taken as strays on members of other orders. Each of the two species of *Haemaphysalis* also appear to be confined to hosts of a single order, though *H. leporispalustris*, which is normally restricted to Lagomorpha, has been secured once from a rodent.

In the dominant genus *Amblyomma*, with nineteen species in Panama, host selectivity varies greatly. Species such as *cajennense* and *oblongoguttatum* occur on hosts of seven or eight different orders, while *longirostre* and *pecarium* are known from only a single species of host. The six species parasitizing Edentata are of some interest. Two, *geayi* and *varium*, are practically confined to the almost entirely arboreal sloths. Three others—

*calcaratum*, *pictum*, and *nodosum*—parasitize the less arboreal anteaters. There are two records of *calcaratum* from sloths. The last species, *auricularium*, is primarily a parasite of the burrowing armadillos, though it is often taken on anteaters and occasionally on hosts of other orders.

Our information on the hosts of the early instars of Panamanian ticks is meager. Most species of *Ornithodoros* can now be determined in the larval stage, but our collections of larvae, other than of species that occur on bats, are limited. In the case of the latter, there is some indication of host preference, but whether this is due to the environmental necessities of the essentially free-living nymphs and adults, or to true host selection by the larvae is not clear from our scanty data. In the case of the Ixodidae, it has been possible to determine the larvae of *Haemaphysalis* and of a few species of *Amblyomma*. It is usually possible to place larvae of the other genera in the correct genus, though we have not critically studied all the numerous lots consisting only of nymphs and larvae.

We have secured adults from engorged nymphs of numerous species. In most cases these nymphs have been taken from hosts different from those generally favored by the adults. Thus, of five reared nymphs of *A. auricularium*, three were from *Philander* (a marsupial), and two from *Sigmodon* (a rodent). The adults are usually found on edentates (armadillos and anteaters). All but one of the adults of *H. juxtakochi* obtained were from deer (*Artiodactyla*) but no early stages were taken from this host. On the other hand, nymphs of this tick were taken from three other species of mammals, two of which belong to other orders (*Rodentia*, *Carnivora*). The case of *A. longirostre*, a specific parasite of the lowland porcupine, *Coendou rothschildi*, has been noted previously by others (Aragão, 1936). We also have secured nymphs of this species, but only from birds, mostly passerines. It is almost certain that the sloth ticks, and undoubtedly other species whose early instars are seldom or never taken on the host with adults, have larval and nymphal hosts far different from those of the adult. Work on the taxonomy of the early instars is an absolute prerequisite to the solving of these problems.

#### Abstract

Forty-seven species of ticks belonging to 10 genera are recorded from Panama. Keys to genera and species are given, and host and locality records for each species are detailed. Extensive host lists and comments on the apparent host preferences of the genera and species are given. The altitudinal and climatic preferences of the various species of Ixodoidea are also discussed and tabulated. No new species are reported, but the following 12 species are new for the fauna of Panama: *Antricola mexicanus* Hoffmann, *Ornithodoros puertoricensis* Fox, *O. viguerasi* Cooley and Kohls, *Ixodes brunneus* Koch, *I. lasallei* Mendez and Ortiz, *I. loricatus* Neumann, *I. pomerantzi* Kohls, *I. tapirus* Kohls, *I. venezuelensis* Kohls, *Dermacentor halli* McIntosh, *D. imitans* Warburton, and *Amblyomma pictum* Neumann.

*Ixodes californicus* Banks is synonymized under *I. brunneus* Koch, and *I. scutierenatus* Vazquez under *I. luciae* Senevet. *Amblyomma avecolens* Cooley and Kohls and *A. curruca* Schulze are reduced to synonyms of *A. longirostre* Koch and *A. auricularium* (Conil), respectively. *A. gertschi* Cooley and Kohls is synonymized under *A. varium* Koch.

## HOST-PARASITE LIST

(N = nymph; L = larva)

## Class AMPHIBIA

## Order SALIENTIA

**Bufo marinus**: 3*Amblyomma dissimile* Koch (3)

## Class REPTILIA

## Order TESTUDINATA

**Geoemyda annulata**: 6*Amblyomma sabanerae* Stoll (6)**Geoemyda funeria**: 3*Amblyomma sabanerae* Stoll (2)

" sp., NN and LL (2)

**Pseudemys scripta**: 3*Amblyomma sabanerae* Stoll (2)" *dissimile* Koch (1)**Kinosternon** sp.: 1*Amblyomma sabanerae* Stoll

## Order SQUAMATA

**Iguana iguana**: 18*Amblyomma dissimile* Koch (16)" *sabanerae* Stoll (2)**Basiliscus basiliscus**: 1*Amblyomma* sp., LL**Ameiva ameiva**: 7*Amblyomma dissimile* Koch (1)

" sp., NN and/or LL (6)

lizards, probably *Ameiva* spp.: 17*Amblyomma* sp., NN and/or LL (17)

## Order SERPENTES

**Constrictor constrictor**: 3*Amblyomma dissimile* Koch (3)**Epicrates** sp.: 1*Amblyomma* sp., NN and LL**Spilotes pullatus**: 1*Amblyomma dissimile* Koch**Pseustes poecilonotus**: 1*Amblyomma dissimile* Koch**Chironius carinatus**: 1*Amblyomma dissimile* Koch**Oxybelis** sp.: 1*Amblyomma* sp., N**Thalerophis richardi**: 1*Amblyomma* sp., LL**Bothrops atrox**: 4*Amblyomma dissimile* Koch (4)**Lachesis muta**: 3*Amblyomma dissimile* Koch (3)

## Class AVES

In addition to the birds listed by name below, we have a considerable number of additional lots, all *Amblyomma* nymphs or larvae, from unidentified birds. Thus, birds seem to be important hosts for the early stages of *Amblyomma*. The few records of adult *Amblyomma* from birds appear to be strays.

## Order TINAMIFORMES

**Crypturellus soui**: 1*Amblyomma* sp., L

## "Tinamou": 1

*Ixodes brunneus* Koch

## Order CICONIIFORMES

**Cochlearius cochlearius**: 1*Amblyomma dissimile* Koch

## Order FALCONIFORMES

**Buteo magnirostris**: 1*Amblyomma cajennense* (Fabricius)**Spizaetus tyrannus**: 1*Amblyomma* sp., N

## Order GALLIFORMES

**Crax rubra**: 2*Amblyomma oblongoguttatum* Koch

" sp., LL

**Penelope purpurascens**: 1*Amblyomma* sp., LL

## domestic fowl: 2

*Amblyomma* sp., NN and LL

## chicken coops: 1

*Argas persicus* (Oken)

## Order CUCULIFORMES

- Neomorphus geoffroyi salvini*: 1  
*Argas persicus* (Oken), N

## Order CORACIIFORMES

- Chloroceryle americana*: 1  
*Amblyomma* sp., LL

## Order PICIFORMES

- Malacoptila panamensis*: 2  
*Amblyomma longirostre* (Koch), NN  
*Capito maculicoronatus*: 1  
*Amblyomma* sp., N  
*Ramphastos* sp.: 1  
*Amblyomma* sp., N

## Order PASSERIFORMES

- Xiphorhynchus* sp.: 1  
*Amblyomma longirostre* (Koch), N  
*Cymbilaimus lineatus*: 1  
*Amblyomma longirostre* (Koch), N

- Thamnophilus nigriceps*: 1

*Amblyomma* sp., N

- Rhytipterna holerythra*: 1

*Amblyomma* sp., N

- Querula purpurata*: 1

*Amblyomma longirostre* (Koch), N

- Cacicus uropygialis microrhynchus*: 2

*Amblyomma longirostre* (Koch), N

- Icterus chrysater*: 1

*Amblyomma longirostre* (Koch), N

- Ramphocelus passerinii*: 8

*Amblyomma* sp., NN

- Tachyphonus rufus*: 1

*Amblyomma* sp., N

- Eucometis penicillata*: 1

*Amblyomma* sp., L

- Saltator maximus*: 1

*Amblyomma longirostre* (Koch), N

- Saltator albicollis*: 1

*Amblyomma longirostre* (Koch), N

- Sporophila aurita corvina*: 9

*Amblyomma* sp., NN

- Arremonops conirostris*: 1

*Amblyomma ovale* Koch, ♀, engorged

## Class MAMMALIA

## Order MARSUPIALIA

## Family Didelphidae

- Caluromys derbianus*: 4  
*Amblyomma geayi* Neumann (1)  
 " sp., NN and/or LL (3)

*Monodelphis adusta*: 1

*Ixodes venezuelensis* Kohls

*Marmosa robinsoni*: 2

*Ixodes luciae* Senevet, N (1)

*Amblyomma sabanerae* Stoll (1)

*Philander opossum*: 24

(Early records from "Philander" generally refer to *Caluromys derbianus*, q.v.)

*Ixodes luciae* Senevet (6)

*Amblyomma auricularium* (Conil) (3)

" *geayi* Neumann (1)

" sp., NN and/or LL (22)

*Metachirus nudicaudatus*: 2

*Ixodes loricatus* Neumann (1)

" sp., NN (1)

*Didelphis marsupialis*: 43

*Ixodes luciae* Senevet (20)

" *boliviensis* Neumann (3)

" *affinis* Neumann (2)

" sp., NN and/or LL (3)

*Amblyomma auricularium* (Conil) (2)

*Amblyomma cajennense* (Fabricius)

(2)

" *geayi* Neumann (1)

" *varium* Koch (1)

" sp., NN and/or LL (20)

*Chironectes minimus*: 1

*Amblyomma oblongoguttatum* Koch

## Order INSECTIVORA

## Family Soricidae

*Cryptotis nigrescens*: 2

*Dermacentor* sp., L

? *Ixodes* sp., L

## Order CHIROPTERA

Infestations of bats with ticks other than *Ornithodoros* were probably accidental. Many of the bats were caught in mist nets and rested on or near the ground for some time. Here they could easily be infested with larval ticks of other genera. In addition to the following, we have a number of records of ticks from unidentified bats.

## Family Emballonuridae

*Peropteryx macrotis*: 2

*Ornithodoros azteci* Matheson, LL

## Family Noctilionidae

## Noctilio labialis: 7

*Ornithodoros hasei* (Schulze), NN and  
LL (7)

## Noctilio leporinus: 3

*Ornithodoros hasei* (Schulze), LL (3)

## Family Phyllostomidae

## Pteronotus parnellii: 1

*Ornithodoros viguerasi* Cooley and  
Kohls, LL

## Pteronotus psilotis: 1

*Antricola mexicanus* Hoffmann, LL  
*Amblyomma* sp., L

## Pteronotus sp.: 1

*Ornithodoros viguerasi* Cooley and  
Kohls, L

## Lonchorhina aurita: 2

*Ornithodoros azteci* Matheson, LL

## Tonatia silvicola: 1

*Ornithodoros hasei* (Schulze), L

## Trachops cirrhosus: 3

*Ornithodoros brodyi* Matheson, LL (3)  
" *hasei* (Schulze), L (1)

## Carollia perspicillata: 4

*Ornithodoros brodyi* Matheson, LL (3)  
*Amblyomma tapirellum* Dunn (1)

## Uroderma bilobatum: 1

*Ornithodoros hasei* (Schulze), LL

## Vampyrops helleri: 2

*Amblyomma cajennense* (Fabricius), ♂  
" sp., N  
*Ornithodoros hasei* (Schulze), LL

## Chiroderma salvini: 1

*Amblyomma* sp., N

## Artibeus sp.: 1

*Ixodes* sp., L

## Family Desmodidae

## Desmodus rotundus: 2

*Ornithodoros azteci* Matheson, LL (1)  
" *brodyi* Matheson, L (1)

## Family Vespertilionidae

## Myotis nigricans: 3

*Dermacentor halli* McIntosh, N  
*Antricola mexicanus* Hoffmann, LL (3)

## Family Molossidae

## Molossus sp.: 1

*Ornithodoros hasei* (Schulze), L

## Order PRIMATES

With the exception of man, ticks are very seldom found on Primates in Panama. We have records of *Amblyomma* nymphs and/or larvae from one individual each of *Alouatta villosa*, *Cebus capuchinus*, and *Aotus trivirgatus*. Two *Saguinus geoffroyi* have yielded ticks, *Rhipicephalus sanguineus* (Latreille) in one case, and *Amblyomma* larva in the other.

## Family Hominidae

## Homo sapiens: 54

Our records do not generally indicate whether the ticks were attached or merely crawling on the skin or clothing. Larvae of *Amblyomma* species are a great pest in many areas, especially during the dry season.

*Amblyomma tapirellum* Dunn (15)  
" *cajennense* (Fabricius)  
(13)  
" *naponense* (Packard) (1)  
" *oblongoguttatum* Koch (9)  
" *ovale* Koch (7)  
" *parvum* Aragão (1)  
" *sabanerae* Stoll (1)  
" sp., NN (11)  
*Ixodes boliviensis* Neumann (4)  
*Rhipicephalus sanguineus* (Latreille)  
(2)  
*Dermacentor latus* Cooley (2)  
" *imitans* Warburton (1)

## Order EDENTATA

## Family Myrmecophagidae

## Myrmecophaga tridactyla: 1

*Amblyomma calcaratum* Neumann  
" *nodosum* Neumann  
" *oblongoguttatum* Koch  
" *tapirellum* Dunn  
" *pictum* Neumann  
" sp., NN

## Tamandua tetradactyla: 30

*Amblyomma calcaratum* Neumann (20)  
" *nodosum* Neumann (19)  
" *auricularium* (Conil) (12)  
" *oblongoguttatum* Koch (7)  
" *cajennense* (Fabricius)  
(3)  
" *naponense* (Packard) (1)  
" *parvum* Aragão (1)  
" sp., NN and/or LL (1)

## Cyclopes didactylus: 2

*Amblyomma* sp., NN and/or LL (2)

## Family Bradypodidae

**Bradypus infuscatus:** 35

- Amblyomma geayi* Neumann (35)  
 " *varium* Koch (12)  
 " sp., NN and/or LL (7)

**Choloepus hoffmanni:** 25

- Amblyomma varium* Koch (16)  
 " *geayi* Neumann (12)  
 " *calcaratum* Neumann (2)  
 " *oblongoguttatum* Koch (1)

## Family Dasypodidae

**Cabassous centralis:** 1

- Amblyomma auricularium* (Conil)

**Dasypus novemcinctus:** 25

- Amblyomma auricularium* (Conil) (22)  
 " *cajennense* (Fabricius) (1)  
 " *oblongoguttatum* Koch (1)  
 " *ovale* Koch (1)  
 " sp., NN and/or LL (2)  
*Ixodes* sp., L (1)

## Order LAGOMORPHA

**Sylvilagus brasiliensis:** 14

- Haemaphysalis leporispalustris* (Packard) (14)  
*Ixodes pomerantzi* Kohls (3)  
*Dermacentor* sp., N (1)  
*Amblyomma* sp., N (1)  
*Ornithodoros puertoricensis* Fox, L (1)

**Oryctolagus cuniculus:** 3

- Rhipicephalus sanguineus* (Latreille) (3)

## Order RODENTIA

## Family Sciuridae

**Sciurus granatensis:** 23

- Ixodes tiptoni* Kohls and Clifford (14)  
 " sp., probably *tiptoni*, LL (3)  
*Amblyomma* sp., NN and/or LL (6)

## Family Heteromyidae

**Liomys adpersus:** 20

- Amblyomma* sp., LL (20)

**Heteromys** sp.: 5

- Amblyomma* sp., NN and/or LL (3)  
*Dermacentor* sp., NN (2)

## Family Cricetidae

**Oryzomys** spp.: 21

- Amblyomma ovale* Koch (2)  
 " sp., NN and/or LL (13)  
*Ixodes luciae* Senevet (1)

*Ixodes venezuelensis* Kohls (1)

" sp., NN and/or LL (4)

*Dermacentor* sp., LL (1)**Reithrodontomys creper** and spp.: 12

- Dermacentor* sp., NN and/or LL (8)  
*Amblyomma* sp., LL (3)  
*Ixodes* sp., N (1)

**Peromyscus** spp.: 23

- Dermacentor* sp., NN and/or LL (11)  
*Amblyomma* sp., NN and/or LL (7)  
*Ixodes* sp., NN and/or LL (5)  
*Haemaphysalis leporispalustris* (Packard), L (1)

**Zygodontomys microtinus:** 16

- Ixodes venezuelensis* Kohls (4)  
 " *luciae* Senevet, N  
*Amblyomma ovale* Koch, N (1)  
 " sp., NN and/or LL (11)

**Scotinomys xerampelinus:** 4

- Ixodes* sp., LL (2)  
*Dermacentor* sp., L (1)  
 ?*Amblyomma* sp., L (1)

**Sigmodon hispidus:** 40

- Amblyomma auricularium* (Conil), N (2)  
 " sp., N and/or LL (38)  
 ?*Ixodes* sp., L (1)

## Family Muridae

**Rattus** sp.: 1

- Ornithodoros puertoricensis* Fox, LL

## Family Erethizontidae

**Coendou mexicanus:** 5

- Dermacentor halli* McIntosh (5)  
*Ixodes boliviensis* Neumann (4)  
 " sp., N and LL (2)

**Coendou rothschildi:** 10

- Amblyomma longirostre* (Koch) (8)  
 " sp., NN and/or LL (5)  
*Haemaphysalis juxtakochi* Cooley, N (1)

## Family Hydrochaeridae

**Hydrochaeris hydrochaeris:** 2

- Amblyomma auricularium* (Conil) (1)  
*Rhipicephalus sanguineus* (Latreille) (1)

## Family Dasypsectidae

**Agouti paca:** 10

- Amblyomma pacae* Aragão (6)  
 " *coelebs* Neumann (1)  
 " sp., NN (3)  
*Ixodes lasallei* Mendez and Ortiz (2)  
 " sp., NN and/or LL (3)

**Dasyprocta punctata:** 14

- Ixodes lasallei* Mendez and Ortiz (8)  
 " sp., NN (1)  
*Amblyomma oblongoguttatum* Koch (3)  
 " *pacae* Aragão (1)  
 " sp., NN and/or LL (5)

**Family Echimyidae****Proechimys semispinosus:** 52

- Amblyomma ovale* Koch, NN (4)  
 " sp., NN and/or LL (48)  
*Ixodes* sp., N (1)  
*Haemaphysalis juxtakochi* Cooley, N  
 (1)

**Hoplomys gymnurus:** 1

- Amblyomma* sp., L

**Order CARNIVORA****Family Canidae****Canis familiaris:** 38

- Rhipicephalus sanguineus* (Latreille)  
 (20)  
*Amblyomma oblongoguttatum* Koch  
 (19)  
 " *ovale* Koch (9)  
 " *cajennense* (Fabricius)  
 (5)  
 " *auricularium* (Conil) (1)  
 " sp., NN and/or LL (5)  
*Ixodes affinis* Neumann (1)  
 " *boliviensis* Neumann (15)

**Family Procyonidae****Procyon lotor:** 1

- Amblyomma ovale* Koch  
*Ixodes boliviensis* Neumann  
 " *rubidus* Neumann

**Procyon cancrivorus:** 3

- Amblyomma ovale* Koch (1)  
 " *oblongoguttatum* Koch (1)  
 " *naponense* (Packard) (1)  
 " sp., NN and/or LL (2)

**Nasua nasua:** 30

- Amblyomma ovale* Koch (12)  
 " *oblongoguttatum* Koch  
 (10)  
 " *auricularium* (Conil) (1)  
 " *cajennense* (Fabricius)  
 (1)  
 " *naponense* (Packard) (1)  
 " sp., NN and/or LL (8)  
*Ixodes rubidus* Neumann (1)  
 " *boliviensis* Neumann (3)  
 " sp., NN and/or LL (2)  
*Haemaphysalis juxtakochi* Cooley (2)

**Potos flavus:** 1

- Amblyomma* sp., N

**Bassaricyon gabbii:** 1

- Ixodes rubidus* Neumann

**Family Mustelidae****Mustela frenata:** 1

- Ixodes rubidus* Neumann

**Eira barbara:** 4

- Amblyomma ovale* Koch (3)  
 " *oblongoguttatum* Koch (1)  
*Ixodes rubidus* Neumann (1)

**Galictis allamandi:** 1

- Amblyomma ovale* Koch  
 " sp., N

**Conepatus semistriatus:** 1

- Ixodes rubidus* Neumann

**Lutra annectens:** 1

- Ixodes* sp., L

**Family Felidae****Felis concolor:** 1

- Amblyomma ovale* Koch

**Felis onca:** 5

- Ixodes boliviensis* Neumann (3)  
 " *affinis* Neumann (2)  
*Amblyomma ovale* Koch (1)  
 " sp., NN

**Felis pardalis:** 4

- Ixodes affinis* Neumann (3)  
*Amblyomma ovale* Koch (3)  
 " sp., NN and LL (1)

**Felis yagouaroundi:** 1

- Amblyomma ovale* Koch

**Felis catus:** 4

- Amblyomma parvum* Aragão (2)  
 " *oblongoguttatum* Koch (1)  
 " sp., NN and/or LL (2)  
*Rhipicephalus sanguineus* (Latreille)  
 (1)  
*Ixodes boliviensis* Neumann (1)

**Order PERISSODACTYLA****Family Tapiridae****Tapirus bairdii:** 11

- Amblyomma oblongoguttatum* Koch (7)  
 " *ovale* Koch (6)  
 " *coelebs* Neumann (5)  
 " *tapirellum* Dunn (5)  
 " *cajennense* (Fabricius)  
 (1)  
 " sp., NN (2)  
*Dermacentor latus* Cooley (3)  
*Ixodes boliviensis* Neumann (3)  
 " *tapirus* Kohls (2)  
*Haemaphysalis juxtakochi* Cooley (1)

## Family Equidae

*Equus caballus*: 43*Amblyomma cajennense* (Fabricius)

(24)

" *oblongoguttatum* Koch

(17)

" *ovale* Koch (2)" *tapirellum* Dunn (1)" *coelebs* Neumann (1)

" sp., NN (1)

*Anocentor nitens* (Neumann) (7)*Boophilus microplus* (Canestrini) (3)(Numerous specimens of *A. nitens*  
collected by Field not included)

## Order ARTIODACTYLA

## Family Tayassuidae

*Tayassu tajacu*: 19*Amblyomma naponense* (Packard) (13)" *oblongoguttatum* Koch

(13)

" *pecarium* Dunn (7)" *tapirellum* Dunn (5)" *cajennense* (Fabricius)

(1)

" sp., NN and/or LL (7)

*Dermacentor imitans* Warburton (4)*Haemaphysalis juxtakochi* Cooley (3)

## Family Suidae

*Sus scrofa*: 7*Anocentor nitens* (Neumann) (7)*Boophilus microplus* (Canestrini) (3)*Amblyomma oblongoguttatum* Koch (3)" *cajennense* (Fabricius)

(2)

" *ovale* Koch (2)*Amblyomma tapirellum* Dunn (2)" *coelebs* Neumann (1)

" sp., NN (1)

## Family Cervidae

*Odocoileus virginianus*: 21*Amblyomma oblongoguttatum* Koch

(18)

" *cajennense* (Fabricius)

(1)

*Haemaphysalis juxtakochi* Cooley (6)*Ixodes affinis* Neumann (4)" *boliviensis* Neumann (1)*Anocentor nitens* (Neumann) (2)*Mazama americana*: 5*Ixodes affinis* Neumann (3)*Amblyomma oblongoguttatum* Koch (2)" *calcaratum* Neumann (1)

" sp., NN (1)

*Haemaphysalis juxtakochi* Cooley (1)

## Family Bovidae

*Bos taurus*: 33*Boophilus microplus* (Canestrini) (23)*Amblyomma cajennense* (Fabricius)

(20)

" *oblongoguttatum* Koch

(15)

" *parvum* Aragão (1)

" sp., NN and/or LL (4)

*Anocentor nitens* (Neumann) (5)*Ixodes boliviensis* Neumann (4)*Capra hircus*: 3*Amblyomma cajennense* (Fabricius)

(1)

" *oblongoguttatum* Koch (1)*Boophilus microplus* (Canestrini) (1)

## References

ANASTOS, G., AND SMITH, C. N.

1957. The male, nymph, and larva of *Ixodes brunneus* Koch (Acarina: Ixodidae).  
Jour. Parasit., 43, (5), pp. 535-541, figs.

ARAGÃO, H. B.

1908. Mais uma nova especie de carrapato brasileiro. Brazil-Medico, 22: 251-252.  
———. Algumas novas espécies de carrapatos brasileiros. Trab. Inst. Manguinhos,  
Rio de Janeiro, pp. 1-14 (reprint).  
1913. Nota sobre algumas coleções de carrapatos brasileiros. Mem. Inst. Oswaldo  
Cruz, 5, (3), pp. 263-271, fig.  
1935. Observações sobre os Ixodideos da Republica Argentina. Ibidem, 30, (3), pp.  
519-533.  
1936. Ixodidas brasileiros e de alguns paizes limitrophes. Ibidem, 31, (4), pp. 759-  
843.

ARAGÃO, H. B., AND DA FONSECA, F.

1951. Notas de Ixodologia. 1. Duas novas espécies do gênero *Ixodes* e um nova nome  
para *Haemaphysalis kochi* Aragão, 1908 (Acari, Ixodidae). Mem. Inst. Oswaldo  
Cruz, 49: 567-574.  
1952. Notas de Ixodologia. 3. Confirmação de *Ixodes aragãoi* Fonseca, 1935, de *Ixodes*  
*amarali* Fonseca, 1935, e lista das espécies do gênero *Ixodes* que ocorrem no Brasil  
(Acari, Ixodidae). Ibidem, 50: 727-728.  
1953. Notas de Ixodologia. 5. A propósito da validade de algumas espécies do gênero  
*Amblyomma* do continente Americano (Acari-Ixodidae). Ibidem, 51: 485-492.  
1961. Notas de Ixodologia. 9. O complexo *ovale* do gênero *Amblyomma*. Ibidem, 59,  
(2), pp. 131-148, figs.

ARTHUR, D. R.

1960. The genera *Dermacentor*, *Anocentor*, *Cosmiomma*, *Boophilus* and *Margaropus*.  
In Ticks, a monograph of the Ixodoidea. Cambridge University Press. Pt. 5. 251  
pp., 510 figs.

BANKS, N.

1904. Some Arachnida from California. Proc. Cal. Acad. Sci., 3, (3), pp. 331-369.

BOERO, J. J.

1945. *Ixodes brunneus* Koch, 1844. Nueva especie para la acarofauna argentina.  
Rev. Med. Veterinaria, 27, (3, 4), pp. 128-130.  
1957. Las Garrapatas de la Republica Argentina (Acarina, Ixodoidea). Depto.  
Editor. Univ. Buenos Aires, 113 pp., 54 pls.

## CANESTRINI, G.

1887. Intorno ad alcuni Acari ed Oplionidi dell 'America. Atti Soc. Veneto-Trent. Sci. Nat., 11: 100-109, figs.

## CLIFFORD, C. M., AND KOHLS, G. M.

1962. Description of the female of *Dermacentor latus* Cooley and of *Amblyomma albopictum* Neumann (Acarina—Ixodidae). Jour. Parasit., 48, (3), pp. 486-489.

## CONIL, P. A.

1878. Description d'une nouvelle espèce d'ixode, *Ixodes auricularius*. Act. Acad. Nac. Cienc. Exact., Buenos Aires, 3, pp. 99-110, figs.

## COOLEY, R. A.

1937. Two new Dermacentors from Central America. Jour. Parasit., 23, (3), pp. 259-264.
1938. The genera *Dermacentor* and *Otocentor* (Ixodidae) in the United States, with studies in variation. Nat. Inst. Health Bull. no. 171, 87 pp.
1946. The genera *Boophilus*, *Rhipicephalus*, and *Haemaphysalis* (Ixodidae) of the New World. Ibidem, no. 187, 54 pp.

## COOLEY, R. A., AND KOHLS, G. M.

1941. *Ornithodoros viguerasi*, a new species of tick from bats in Cuba (Acarina: Ixodoidea). Pub. Health Rept., 56: 396-399.
1944. The Argasidae of North America, Central America and Cuba. Amer. Midl. Nat. Monog., no. 1. 152 pp.
- , The genus *Amblyomma* (Ixodidae) in the United States. Jour. Parasit., 30, (2), pp. 77-111.
1945. The genus *Ixodes* in North America. Nat. Inst. Health Bull., no. 184. 246 pp.

## DAVIS, G. E.

1955. Observations on the biology of the argasid tick *Ornithodoros puertoricensis* Fox. Jour. Parasit., 41, (1), pp. 76-79.

## DIAS, J. A. T. SANTOS.

1954. Um novo nome para o "*Ixodes loricatus spinosus*" Nuttall, 1910 (Nomen bis lectum). Documentário "Moçambique," no. 79, pp. 79-81.
1958. Notes on various ticks (Acarina-Ixodoidea) in collections at some entomological institutes in Paris and London. Anais Inst. Med. Trop., 15, (2), pp. 459-563.
1961. Reabilitação de duas espécies neotrópicas do género *Amblyomma* Koch, 1844 (Acarina-Ixodoidea). Anais Serv. Veter. Moçambique, 7, (1955-1959), pp. 237-243.

## DIAS-UNGRIA, C.

1957. Nota sobre las especies de Acarina de Venezuela. Rev. Sanid. Asist. Social, 22, (5-6), pp. 457-467.

## DUNN, L. H.

1915. Observations on the preoviposition, oviposition, and incubation periods of *Dermacentor nitens* in Panama (Arach., Acar.). Ent. News, 26: 214-219.
1918. Studies on the iguana tick, *Amblyomma dissimile*, in Panama. Jour. Parasit., 5, (1), pp. 1-10.
1923. The ticks of Panama, their hosts, and the diseases they transmit. Amer. Jour. Trop. Med., 3, (2), pp. 91-104.
1927. Notes on two species of South American ticks, *Ornithodoros talaje* Guérin-Méne, and *Ornithodoros venezuelensis* Brumpt. Jour. Parasit., 13, (3), pp. 177-182.
1931. Notes on the tick *Ornithodoros talaje* (Guer.) infesting a house in the Canal Zone. Psyche, 38, (4), pp. 170-173.

1933. Two new species of ticks from Panama (*Amblyomma tapirellum* and *A. pecarium*). *Parasitology*, 25, (3), pp. 353-358.
- Observations on the host selection of *Ornithodoros talaje* Guerin in Panama. *Amer. Jour. Trop. Med.*, 13, (5), pp. 475-483.
1934. Ticks from tapirs of Panama. *Jour. Parasit.*, 20, (5), p. 312.
- 1934a. Entomological investigations in the Chiriqui region of Panama. *Psyche*, 41, (3), pp. 166-183.
- DUNN, L. H. AND CLARK, H. C.
1933. Notes on relapsing fever in Panama with special reference to animal hosts. *Amer. Jour. Trop. Med.*, 13, (2), pp. 201-209.
- EDDY, G. W., AND JOYCE, C. R.
1942. Ticks collected on the Tama (Iowa) Indian Reservation with notes on other species. *Iowa State Jour. Sci.*, 16, (4), pp. 539-543.
- FABRICIUS, J. C.
1787. *Mantissa insectorum sistens species nuper detectas adiectis synonymis, observationibus, descriptionibus, emendationibus*. 2. 382 pp. Hafniae.
- FAIRCHILD, G. B.
1943. An annotated list of the bloodsucking insects, ticks and mites known from Panama. *Amer. Jour. Trop. Med.*, 23, (6), pp. 569-591.
- FLOCH, H., AND FAURAN, P.
1958. *Ixodides de la Guyane et des Antilles Françaises*. *Arch. Inst. Pasteur Guyane franç. et Inini*, no. 446, pp. 1-94, figs.
- FONSECA, F., DA.
1935. *Notas de Acareologia*. 15. Occorrença de sub-espécie de *Ixodes ricinus* (L., 1758) no estado de S. Paulo (Acarina, Ixodidae). *Mem. Inst. Butantan*, 9: 131-135.
1960. *Notes d'acarologie*. 45. Enquête acarologique au Pérou. *Acarologia*, 2, (1), pp. 1-34.
- FOX, I.
1947. *Ornithodoros puertoricensis*, a new tick from rats in Puerto Rico. *Jour. Parasit.*, 33, (3), pp. 253-259.
1951. Relative and seasonal abundance of the common rat ectoparasites of San Juan, Puerto Rico. *Jour. Parasit.*, 37, (1), pp. 85-95.
- FOX, I., AND GARCIA-MOLL, I.
1961. Rat ectoparasite surveys in relation to murine typhus in Puerto Rico. *Amer. Jour. Trop. Med. Hyg.*, 10, (4), pp. 566-573.
- GUÉRIN-MÉNEVILLE, F. E.
1849. Description de l'*Argas talaje*. *Rev. et Mag. Zool.*, 1: 342-344, pl. 9.
- HOFFMANN, A.
1959. Una especie de *Antricola* encontrada en México (Acar., Argas.). *An. Esc. Nac. Cienc. Biol.*, 9, (1958) pp. 97-102.
- KARSCH, F.
1880. Vier neue Ixodiden des Berliner Museums. *Mitt. Münch. Ent. Ver.*, 4: 141-142.
- KOCH, C. L.
1844. Systematische Uebersicht über die Ordnung der Zecken. *Arch. Naturg.*, 10, (1), pp. 217-239.

## KOHLS, G. M.

1953. *Ixodes venezuelensis*, a new species of tick from Venezuela, with notes on *Ixodes minor* Neumann, 1902 (Acarina: Ixodidae). Jour. Parasit., 39, (3), pp. 300-303.
1956. The identity of *Ixodes boliviensis* Neumann, 1904 and *I. bicornis* Neumann, 1906 (Ixodidae). Proc. Ent. Soc. Wash., 58, (4), pp. 232-233.
1957. Eight new species of *Ixodes* from Central and South America (Acarina: Ixodidae). Jour. Parasit., 42, (6), pp. 636-649. (Dec. 1956).
- . *Ixodes downsi*, a new species of tick from a cave in Trinidad, British West Indies (Acarina-Ixodidae). Proc. Ent. Soc. Wash., 59, (6), pp. 257-264.
1958. *Amblyomma imitator*, a new species of tick from Texas and Mexico, and remarks on the synonymy of *A. cajennense* (Fabricius) (Acarina-Ixodidae). Jour. Parasit., 44, (4), pp. 430-433.
1960. Records and new synonymy of New World *Haemaphysalis* ticks, with descriptions of the nymph and larva of *H. juxtakochi* Cooley. Ibidem, 46, (3), pp. 355-361.

## KOHLS, G. M., AND CLIFFORD, C. M.

1962. *Ixodes tiptoni*, a new species of tick from Panama (Acarina-Ixodidae). Jour. Parasit., 48, (2), pp. 182-184.

## KOHLS, G. M., AND ROGERS, A. J.

1953. Note on the occurrence of the tick *Ixodes affinis* Neumann in the United States. Ibidem, 39, (6), p. 669.

## LAHILLE, F.

1905. Contribution á l'étude des Ixodidés de la Republique Argentine. An. Minist. Agri., Sec. Zootechnia, Bact., Vet., Zool., 2, (2), 166 pp.

## LATREILLE, P. A.

1806. Genera crustaceorum et insectorum, etc. 1. xviii + 302 pp.

## LEÓN, L. A., AND DE LEÓN, B. C.

1947. Estado actual de los conocimientos sobre la fiebre recurrente en el Ecuador. Kuba, 3, (7), pp. 145-150.

## LUND, H. O., MARSHALL, C. M., AND HAYES, F. A.

1962. The occurrence of *Ixodes affinis* Neumann on Blackbeard Island, Georgia. Proc. Ent. Soc. Wash., 64, (2), pp. 105-106.

## MATHESON, R.

1935. Three new species of ticks, *Ornithodoros* (Acarina, Ixodoidea). Jour. Parasit., 21, (5), pp. 347-353.
1941. A new species of tick, *Ornithodoros anduzei*, (Ixodoidea, Argasidae) from bat caves in Venezuela. Bol. Ent. Venezolana, 1, (1), pp. 3-5.

## MAZZOTTI, L.

1943. Una nueva especie de *Ornithodoros* en Mexico. Revista Inst. Salub. Enferm. Trop., 4, (4), pp. 371-374.
1949. Sobre una nueva espiroqueta de la fiebre recurrente, encontrada en Mexico. Ibidem. 10, (3), pp. 277-281.

## MCINTOSH, A.

1931. A new species of tick from the Texas peccary. Jour. Parasit., 18: 121.
1932. Description of a tick *Dermacentor halli* from the Texas peccary, with a key to the North American species of *Dermacentor*. Proc. U. S. Nat. Mus., 82, art. 4, pp. 1-6, figs.

MENDEZ-ARROCHA, M., AND ORTIZ, I.

1957. Descripción del macho y redescrpción de la hembra de *Amblyomma crassum* Robinson, 1926 (Acarina: Ixodidae). Mem. Soc. Cienc. Nat. LaSalle, 17: 190-199.  
 1958. Revisión de las garrapatas venezolanas del género *Ixodes* Latreille, 1795 y estudio de un nuevo *Amblyomma* (Acarina: Ixodidae). Ibidem, 18: 196-208.

MINNING, W.

1934. Beiträge zur Systematik und Morphologie der Zeckengattung *Boophilus* Curtice. Zeitschr. f. Parasitenk., 7: 1-43, figs.

NEUMANN, L. G.

1897. Révision de la famille des Ixodidés. Mém. Soc. Zool. France, 10: 324-420.  
 1899. Révision de la famille des Ixodidés. Ibidem, 12: 107-294.  
 1901. Révision de la famille des Ixodidés. Ibidem, 14, pp. 249-372.  
 1904. Notes sur les Ixodidés, 2. Arch. Parasit., 8, (3), pp. 444-464.  
 1906. Notes sur les Ixodidés, 4. Ibidem, 10, (2), pp. 195-219.

NUTTALL, G. H. F.

1910. New species of ticks (*Ixodes*, *Amblyomma*, *Rhipicephalus*). Parasitology, 3: 408-416.

NUTTALL, G. H. F., AND WARBURTON, C.

1911. Ixodidae, Section 2, The Genus *Ixodes*. In Ticks, a monograph of the Ixodoidea, by Nuttall, Warburton, Cooper and Robinson. Cambridge University Press. Pt. 2. pp. 133-348, 4 pls.

OKEN, L.

1818. Sogenannte giftige Wanze in Persien. Isis, pp. 1567-1570, pl. 19, figs. 1-4.

OSORNO-MESA, E.

1941. Las garrapatas de la Republica de Colombia. Anuario Acad. Nac. Med., 1938-1940: 398-434. Bogota.

PACKARD, A. S.

1869. List of hymenopterous and lepidopterous insects collected by the Smithsonian Expedition to South America, under Prof. James Orten; appendix to report on Articulates. Ann Rept. Peabody Acad. Sci., pp. 56-69.

RINGUELET, R.

1947. La supuesta presencia de *Ixodes brunneus* Koch en la Argentina y descripción de una nueva garrapata *Ixodes neuquenensis* nov. sp. Notas Mus. La Plata, 12: 207-216.

ROBINSON, L. E.

1926. The genus *Amblyomma*. In Ticks, a monograph of the Ixodoidea, by Nuttall, Warburton, Cooper and Robinson. Cambridge University Press. Pt. 4. pp. xii + 302, 7 pls.

DE RODANICHE, E.

1953. Natural infection of the tick *Amblyomma cajennense* with *Rickettsia rickettsii* in Panama. Amer. Jour. Trop. Med. Hyg., 2: 696-699.

SCHULZE, P.

1935. Zur vergleichenden Anatomie de Zecken. (Das Sternale, die Mundwerkzeuge, Analfurchen und Analbeschilderung und ihre Bedeutung, Ursprünglichkeit und Luxurieren. Zeitschr. f. Morph. u. Ökol. der Tiere, 30: 1-40.  
 1936. Neue und wenig bekannte Amblyommen und Aponommen aus Afrika, Südamerika, Indien, Borneo und Australien. (Ixodidae.) Zeitschr. f. Parasitenk., 8, (6), pp. 619-637.

1937. Beiträge zur Kenntnis der Zeckengattung *Amblyomma*. Ibidem, 9, (6), pp. 690-694.
- . *Anocentor columbianus* n. g. n. sp. (Ixod.). Zool. Anz., 120, (1-2), pp. 24-27.
1941. Das Geruchsorgan der Zecken. Untersuchungen über die Abwandlungen eines Sinnesorgans und seine stammesgeschichtliche Bedeutung. Zeitschr. f. Morph. u. Ökol. der Tiere, 37: 491-564.
- SENEVET, G.  
1940. Quelques Ixodidés de la Guyane française. Espèces nouvelles d'*Ixodes* et d'*Amblyomma*. VI Congr. Intern. Ent. pp. 891-898, Madrid (1935).
- STOLL, O.  
1886-1893. Arachnida Acaridea. Biologia Centrali-Americana, Zoologia. London, pp. v-xxi, 1-55, 21 plates.
- VARGAS, L.  
1955. Relacion del papel patogeno de las garrapatas y lista de las especies Mexicanos. Gaceta Med. de Mexico, 85, (4-5), pp. 489-502.
- VAZQUEZ, L.  
1946. *Ixodes scuticrenatus*, una especie nueva de garrapata de Mexico. An. Inst. Biol., 17, (1-2), pp. 237-245.
- VOGELSANG, E. G., AND DIAS, J. A. T. SANTOS.  
1953. Nueva contribucion al estudio de la fauna ixodologica en Venezuela. Rev. Med. Vet. Parasit., 12, (1-4), pp. 63-89.
- WARBURTON, C.  
1933. On five new species of ticks (Arachnida, Ixodoidea). Parasitology, 24, (4), pp. 558-568.